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VOL. CXXXV.—No. 3501] LONDON: FRIDAY EVENING, FEBRUARY 2, 1923 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Girder Bridge Design.

Two New Drilling Machines.

Electric Drive in Naval Vessels.

Super Power Stations and the Supply of Electricity.

Some Notes on an Old Windmill.

Utilisation of Heavy Fuel Oils.

A Large Electric Winding Plant.

PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of :—

1. SPIKES, SCREW, STEEL.
2. SPRINGS, HELICAL AND VOLUTE.
3. MATERIALS FOR RAILWAY CARRIAGES.

Forms of Tender may be obtained from the Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Friday, the 23rd February, 1923, for Nos. 1 and 2, and on Tuesday, the 6th March, 1923, for No. 3.

T. RYAN,
1390 Director-General.

University of London.

A COURSE of FOUR LECTURES on "THE CONTROL OF THE SPEED AND POWER FACTOR OF INDUCTION MOTORS" will be given by PROFESSOR MILES WALKER, M.A., D.Sc. (Professor of Electrical Engineering in the University of Manchester), at the INSTITUTION OF ELECTRICAL ENGINEERS, Savoy-place, Victoria Embankment, W.C. 2, on WEDNESDAY, FEBRUARY 21st; MONDAY, FEBRUARY 26th; WEDNESDAY, MARCH 14th; and WEDNESDAY, MARCH 21st, 1923, at 5.15 p.m. At the first Lecture the chair will be taken by the President of the Institution of Electrical Engineers (Frank Gill, Esq.). Syllabus of the Lectures obtainable on application to the undersigned. ADMISSION FREE, WITHOUT TICKET.

EDWIN DELLER,
1383 Academic Registrar.

Artillery College, Woolwich.

DEPARTMENT OF MECHANICAL AND ELECTRICAL ENGINEERING.

(PROFESSOR J. J. GUEST, M.A., M.I.M.E.).

APPLICATIONS are INVITED for the POST of SENIOR LECTURER in the Mechanical Engineering Section. Salary £500 to £600 per annum. Post is pensionable under the Federated Superannuation Scheme for Universities.

Applications should be made, in writing only, before 15th February, 1923, to the ADJUTANT, Artillery College, Red Barracks, Woolwich, S.E. 18, from whom further particulars can be obtained. 1329

The Norton and Gregory Annual SCHOLARSHIPS IN ENGINEERING,

Offered by NORTON and GREGORY, Ltd., London.

HONORARY COMMITTEE:

Sir JOSEPH PETAVEL, K.B.E., D.Sc., F.R.S., Director of the National Physical Laboratory, Teddington (Chairman).
Professor C. E. INGLIS, M.A., Professor of Engineering, Cambridge University (Vice-Chairman).
Professor E. G. COKER, D.Sc., F.R.S., Dean of the Faculty of Engineering, University of London, University College, Gower-street, W.C. 1.
J. TALBOT, Esq., T.D., M.C., B.Sc., Master of Hailebury College (Appointed by the Committee of the Headmasters' Conference).
G. H. BURKHARDT, Esq., M.A., M.Sc., Principal of Swindon and North Wilts Secondary School and Technical Institution, Swindon (Appointed by the Incorporated Association of Headmasters).
Together with the Chairman and the Managing Director of Messrs. Norton and Gregory, Ltd.

Messrs. Norton and Gregory, Ltd., offer Two Engineering Scholarships to be competed for annually, one value £100 per annum, and one value £50 per annum, tenable for three years at any University in the United Kingdom or British Dominions approved by the Committee.

A sum sufficient to cover the Scholarships now offered has been deposited by the Donors in the names of the Chairman and Vice-Chairman of the Committee.

Candidates must have reached the age of 17, but not the age of 19, on 1st March in the year of Examination, be domiciled in the United Kingdom, and undertake to pursue a three years' course in Engineering with a view to following it as a profession.

Papers, which will cover two days' Examination, will be set in the following four subjects :—

English,
Mathematics,
Mechanics,
General Physics.

The Examination for the 1923 Scholarships will be held in March at a date to be fixed later, and all Application Forms must reach the Committee not later than 15th February, 1923.

Full particulars and official Application Forms may be obtained from

The SECRETARY,
SCHOLARSHIPS COMMITTEE,
Messrs. Norton and Gregory, Ltd.,
1 and 2, Castle-lane,
1264 Westminster, London, S.W. 1.

City of Leicester.

ADDITIONAL PUMPING MACHINERY AT ABBEY PUMPING STATION AND BEAUMONT LEYS SEWAGE FARM.

The Sewage Works and Farms Committee of the Leicester City Council invite preliminary PROPOSALS, DESIGNS and QUOTATIONS for STEAM, ELECTRICAL, or other type of PUMPING MACHINERY in connection with the Sewage Disposal of the City.

Particulars, together with general conditions, outline specification, plans showing sites, &c., may be obtained at the City Surveyor's office on payment of the sum of £5 (Five Pounds), which will be returned on the receipt of a bona fide Proposal and Quotation.

Cheques, &c., to be made payable to the Leicester Corporation and sent to the City Treasurer.

Proposals and Quotations on the form supplied, addressed to "The Chairman of the Sewage Works and Farms Committee, Town Hall, Leicester," are to be delivered not later than Twelve Noon, Monday, 12th March, 1923, and endorsed "Pumping Machinery."

The Committee do not bind themselves to accept any Proposal or Quotation.

The acceptance of any Proposal and Quotation will be subject to the approval of the City Council and the Ministry of Health.

E. GEORGE MAWBEY, M. Inst. C.E.,
City Engineer and Surveyor.
Town Hall, Leicester,
January, 1923. 1347

Municipality of the City of PORT ELIZABETH.

GENERAL ENGINEERING ASSISTANT REQUIRED for service with the above municipality. Salary £380, rising to £480 per annum. Three years' agreement. Second-class passage out paid.—Apply by letter by the 16th February, stating age and qualifications and enclosing copies of testimonials, to

DAVIS and SOPPER, Limited,
Agents of the Port Elizabeth Municipality,
1412 54, St. Mary Axe, London, E.C. 3.

PUBLIC NOTICES

Borough of Portsmouth.

QUAY WIDENING IN REINFORCED CONCRETE.

The Portsmouth Town Council invite DESIGNS and TENDERS for the CONSTRUCTION and MAINTENANCE in thorough repair for twelve calendar months from the completion thereof of the following WORKS, that is to say :—

THE WIDENING of a PORTION of the QUAY in the Outer Camber, Portsmouth, in Reinforced Concrete Construction, 180ft. long and varying in width from 8ft. to 10ft.

Copies of drawings of the scheme, the conditions of tendering and the general conditions under which the Designs and Tenders are invited, can be obtained on application (accompanied by the sum of £5 5s., which will be refunded on the return of the documents within three days on the receipt of a bona fide Tender, accompanied by the documents required) to Mr. Arthur W. Ward, Borough Engineer, Town Hall, Portsmouth, from whom any further particulars can be obtained.

The work will have to be carried out under the requirements of the Government Unemployment Grants Committee and the trade union rules in force in the Borough.

No design will be considered unless accompanied by a firm Tender.

Tenders, marked "Tender for Widening Quay, Portsmouth Camber," are to be sent in on the form supplied, accompanied by the drawings, &c., issued by the Corporation, together with the tenderer's design, specification, quantities, &c., as required in the conditions of Tender, and must reach the undersigned not later than 10 a.m. on Tuesday, 6th March, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

F. J. SPARKS,
Town Clerk.
The Town Hall, Portsmouth,
29th January, 1923. 1403

Madras and Southern Mahratta RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for TWO LOCOMOTIVE ENGINES and TENDERS (Standard Passenger Superheated 4-6-0 Type), Broad Gauge,

in accordance with the specification, which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Friday, 16th February, 1923, marked "Tender for Loco. Engines and Tenders."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices :
25, Buckingham Palace-road,
Westminster, S.W. 1. 1428

County Borough of Halifax.

The Tramways and Electricity Committee of the Halifax Corporation are prepared to accept OFFERS for the PURCHASE of a 750 K.W. DIRECT-COUPLED BELLISS ENGINE and ELECTRIC CONSTRUCTION CO.'s DIRECT-CURRENT DYNAMO, 450 to 560 volts, together with a SURFACE CONDENSER.

Full particulars can be obtained on application to Mr. W. M. Rogerson, M. Inst. E.E., Borough Electrical Engineer, Electricity Department, 29, Northgate, Halifax.

The highest or any Tender will not necessarily be accepted.

Tenders to be delivered to the undersigned not later than Twelve Noon on Tuesday, February 6th, 1923.

By Order,
PERCY SAUNDERS,
Town Clerk
Town Hall, Halifax,
25th January 1923 1253

PUBLIC NOTICES

City of Nottingham.

NORTH WILFORD POWER STATION, CONTRACT NO. 3 TO STRUCTURAL ENGINEERS.

The Electricity Committee is prepared to receive TENDERS from firms capable of undertaking a contract for about :—

1350 TONS of STEEL WORK in Stanchions, Girders, Beams, Roof Trusses, &c.
90 TONS of GALVANISED WORK in Corrugated Sheeting, Chimney Aprons, Louvres, &c.
90 TONS of CAST IRON in Gutters, &c.,

required in connection with the construction of the above Station.

Drawings may be seen and copies of general conditions of contract, specification, bill of quantities and form of Tender, &c., may be obtained on and after Monday, 5th February, 1923, on application to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of Two Pounds, which will not be returned.

Sealed Tenders, duly stating the time required for the completion of the work, are to be delivered in the official envelope provided, to the undersigned on or before Thursday, 22nd February, 1923.

The lowest or any Tender will not necessarily be accepted, and the Committee reserve to themselves the right of dividing the work in any way they shall think fit, and Tenders will only be accepted from firms who conform to the conditions of the contract, as regards paying the local standard rate of wages, &c., and to the working rules of the Nottingham district.

By Order,
W. J. BOARD,
Town Clerk.
Guildhall, Nottingham,
29th January, 1923. 1406

Richmond Main Sewerage Board.

STORM WATER TANKS.

The Board are prepared to receive TENDERS for the CONSTRUCTION of TANKS, EFFLUENT and SEWAGE CHANNELS, SLUDGE DRAINS, and other WORKS at the Main Drainage Works in the Parish of Mortlake, Surrey.

Specification and drawings may be inspected at the office of Mr. William Fairley, M. Inst. C.E., Parliament Mansions, Westminster, S.W., also at the Main Drainage Works, West Hall-road, Kew Gardens, where copies of the bill of quantities will be available after Saturday, 3rd February, and may be obtained on deposit of a crossed cheque for £3 3s., made payable to the Board, which deposit will be returned on receipt of a bona fide Tender.

Sealed Tenders, on forms provided, must be received by the undersigned on or before Twelve o'clock Noon, Wednesday, 14th February, 1923.

Security for the due fulfilment of the contract will be required in accordance with the provisions of the Public Health Act, 1875.

The Board do not bind themselves to accept the lowest or any Tender.

J. LESLIE G. POWELL,
Clerk to the Board.
The Sessions House,
Richmond, Surrey,
29th January, 1923. 1398

The East India Tramways Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

TRAM RAILS.
FISH-PLATES.
TIE BARS, &c.

Specification and quantities can be obtained from the Company's Engineer, J. D. Abbott, Esq., 18, Victoria-street, S.W. 1.

Tenders must be submitted not later than Noon on Wednesday, 14th February, 1923, at the Company's Office, 79, Lombard-street, E.C. 3.

The Directors do not bind themselves to accept the lowest or any Tender.

E. P. WILLIAMS,
1409 Secretary.

PUBLIC NOTICES

Administrative County of LONDON.

The London County Council invites TENDERS for GENERAL WORKS and REPAIRS (including Jobbing Work) exclusive of works of a mechanical character, to Sewers, Engine-houses, Buildings, Bridges, Subways, Tunnels, &c., under the supervision of the Chief Engineer of the Council, on a schedule of prices for a contract for twelve months commencing 1st April, 1923.

Tenders are asked for as follows :—

(a) For the whole of the Works on both sides of the River Thames.
(b) For the Works on the North Side of the River Thames only, but including Thames Bridges and Tunnels.
(c) For the Works on the South Side of the River Thames only.

Persons desiring to submit Tenders may obtain on and after Monday, 5th February, 1923, the schedule of prices, form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £2. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender, and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract document may be inspected before the payment of the fee.

No Tender received after 4 p.m. on Monday, 26th February, 1923, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
1425 Clerk of the London County Council.

Administrative County of LONDON.

REMOVAL OF SEWER DEPOSIT.

The London County Council invite TENDERS for the REMOVAL and DISPOSAL of SEWER DEPOSIT and other Material in connection with the Main Drainage, &c., Services for four districts—two north of the Thames and two south of the Thames, east and west respectively, for a contract for twelve months commencing 1st April next.

Persons desiring to submit Tenders may obtain on and after Monday, 5th February, 1923, the schedule of prices, form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £1. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender, and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract document may be inspected before the payment of the fee.

No Tender received at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 26th February, 1923, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
1426 Clerk of the London County Council.

Administrative County of LONDON,

SOUTH-WESTERN STORM RELIEF SEWER. CONTRACT No. 2.

The London County Council invites TENDERS for the CONSTRUCTION in Tunnel of an 11ft. 4in. internal diameter SEWER in Iron, of a total length of about 1 3-8 miles, together with Outlet to the River Thames, Weir Chambers, Tumbling Bays, Side Entrances, &c., in the Metropolitan Boroughs of Lambeth, Wandsworth and Battersea.

The specification, form of Tender, &c., may be obtained on application to the Chief Engineer of the Council at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £10. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender, and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before the payment of the fee.

No Tender received at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 26th February, 1923, will be considered. The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
1427 Clerk of the London County Council.

Borough of Taunton.

APPOINTMENT OF TEMPORARY ASSISTANT IN BOROUGH SURVEYOR'S DEPARTMENT.

A TEMPORARY ASSISTANT is REQUIRED in the Borough Surveyor's Department to assist in the preparation of plans, &c., for Sewage Disposal Works. Knowledge of concrete work essential. Applications, stating age, experience and salary required, together with not more than three recent testimonials, must reach the undersigned not later than the 10th February next.

IVOR F. SHELLARD, Assoc. M. Inst. C.E.,
Borough Surveyor and Engineer,
Municipal Buildings, Taunton,
29th January, 1923. 1379

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PUBLIC NOTICES

Stepney Borough Council.

ELECTRICITY SUPPLY.

RIVER WATER SCREENING APPARATUS.

The Electricity Supply Committee of the Stepney Borough Council invite TENDERS from responsible contractors for the carrying out of the following, viz.:—

The MANUFACTURE, SUPPLY and ERECTION complete of a RIVER WATER SCREENING APPARATUS to be fixed in a well on the Council's Wharf at their Limehouse Generating Station.

Copies of the general conditions, specification, form of Tender and drawings may be obtained from Mr. Wm. C. F. Tapper, M.I.E.E., Borough Electrical Engineer and Manager, No. 27, Osborn-street, Whitechapel, London, E. 1, upon receipt of a deposit of Five Guineas. Deposits will be returned to bona fide tenderers after the Tenders have been considered by the Council. Additional copies, with drawings, may be obtained upon payment of the sum of One Guinea, which will not be returned. Copies of the specification and drawings may be inspected at the above-mentioned address by appointment.

Tenders, on the form supplied, endorsed "Tender for Screening Apparatus," must be delivered, signed, sealed and addressed to the Chairman of the Electricity Supply Committee, at No. 27, Osborn-street, Whitechapel, London, E. 1, not later than March 1st, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

GEO. W. CLARKE,
Town Clerk.

Municipal Offices,
Raine-street, Old Gravel-lane, E. 1,
29th January, 1923. 1422

The Great Indian Peninsula

RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely :—

	Fee for Specification.
No. 1—SCREW JACKS	5s.
No. 2—STEEL WORK for BRIDGES ..	10s.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Screw Jacks," or as the case may be, not later than Eleven o'clock a.m. on the Tuesday, the 13th February, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
43, Copthall-avenue, E.C. 2,
London, 31st January, 1923. 1434

The South Indian Railway Com-

PANY, Limited, are prepared to receive TENDERS for the SUPPLY of :—

STRUCTURAL STEEL WORK for CARRIAGE REPAIR SHOP and WHEEL SHOP, Trichinopoly Workshops Scheme.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Structural Steel Work," must be left with the undersigned not later than Twelve Noon on Friday, the 2nd March, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of the specification.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 2, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
31st January, 1923. 1437

CONSTRUCTION OF MAIN ROAD, NEWCASTLE TO THE COAST.

The Joint Committee of the

Local Authorities of Newcastle-upon-Tyne, Longbenton, Wallsend and Tynemouth, invite APPLICATIONS for the POSITION of RESIDENT ENGINEER on the Construction of a Main Road, about 5 miles in length, between Newcastle-upon-Tyne and Tynemouth.

Applicants should be fully qualified civil engineers; preference will be given to the applications of corporate members of the Institution of Civil Engineers or members of the Institution of Municipal and County Engineers. Experience in the carrying out of large public works, particularly road construction, is essential.

The appointment will be of a temporary nature and will terminate when the works are completed.

Applications, stating qualifications, experience, and salary required, together with copies of three testimonials, to be addressed to the City Engineer, Town Hall, Newcastle-upon-Tyne, in a sealed envelope, endorsed "Application for Resident Engineer," and to be delivered not later than 10 a.m. on the 12th February, 1923.

By Order,
A. M. OLIVER,
Town Clerk.

Town Hall,
Newcastle-upon-Tyne. 1423

SITUATIONS OPEN

WANTED, a GENTLEMAN, Resident in London or suburbs, to REPRESENT an established ENGINEERING SPECIALITY in connection with municipal loading; good engineer.—Address, P6850, The Engineer Office. P6850 A

WANTED, a LIVE MAN with Wide Experience of Machine and Small Tool Trade, for important position with large firm of factors. State age, experience and salary required.—Address, 1381, The Engineer Office. 1381 A

WANTED by an Old-established Firm of Engineers and Ironfounders in the Midlands, a fully qualified METALLURGIST, thoroughly experienced in Grey Iron Castings and in the use of Alloy Steels. Liberal salary will be paid. Only first-class men need apply.—Address, giving age, previous experience, testimonials (copies only), and salary required, 1421, The Engineer Office. 1421 A

WANTED by Firm in Westminster District, Energetic young ENGINEER as Representative, commencing on commission basis; good prospects to suitable man.—Address, P6845, The Engineer Office. P6845 A

WANTED, CIVIL ENGINEER as CONTRACTORS' AGENT for Deep Foundations Contract; must be thoroughly experienced and reliable. Give references and state salary required.—Address, 1433, The Engineer Office. 1433 A

WANTED, First-class ENGINEER-SALESMAN as LONDON REPRESENTATIVE to British Firm of Manufacturers. Must be thoroughly conversant with the latest practice in internal combustion engineering. Good salary to right man. Must be keen, of good address, and able to get results. State experience, salary expected, and other particulars in strict confidence.

Address, P6774, The Engineer Office. P6774 A

WANTED in Midland District, a PRACTICAL ENGINEER. Must have some practical experience of Electrical Installation and Working. Applicants with a knowledge of the Steel Tube Trade will receive special attention. State salary required, experience, with copies of testimonials.—Address, 1472, The Engineer Office. 1472 A

SITUATIONS OPEN (continued)

WORKING MECHANICAL ENGINEER (Single) REQUIRED to take Complete Charge of Steam Power Plant of a Fibre-decorticating Factory in Zambesi district. Must be capable of doing all Running Repairs to Boilers, Engines, Machinery, &c. Preference will be given to one having sufficient knowledge to maintain a small D.C. Electric Lighting Plant and Centrifugal Pumps. Three years' agreement at a salary of £600 per annum. Quarters provided, and passage out and home.—Write, sending particulars of qualifications and copies of testimonials, stating age, to "M. D.," c.o. Street's, 30, Cornhill, E.C. 3. 1430 A

WANTED, QUALIFIED MANAGER to TAKE CHARGE of small QUARRIES and GRINDING PLANT. Full control.—Address, P6821, The Engineer Office. P6821 A

CEMENT WORKS ENGINEER WANTED for India, preferably one with 1st Class B.O.T. Certificate. Applicants must be experienced in operation and maintenance of modern Rotary Kiln Cement Plant, Workshop and Steam Turbines. Salary Rs. 400 to Rs. 700 per month, according to qualifications; plainly furnished quarters with light, fuel and water supplied free. Two or three years' agreement, with second-class passage out and home, will be granted to suitable engineer.—Address, with full particulars, 1405, The Engineer Office. 1405 A

DESIGNING ENGINEER for Switchgear WANTED in London area. Applicants must have intimate knowledge of up-to-date designs. Sound practically and technically.—Address particulars of age, salary, and experience, 1276, The Engineer Office. 1276 A

ELECTRICIAN-ORGANISER for London Engineering Works, to specialise in the preparation of quotations and the handling in office of work connected with dynamos from ¼ to 5 K.W. and apparatus associated therewith.

Must have good knowledge of D.C. Machines, Auto. Controls and Switchgear, good mathematical knowledge and exceptional ability in technical and commercial correspondence.

Permanent and progressive position for really good man. Age 35-45. State age, experience, and salary required.—Write, L. E. W., at Hornecastle's, 60, Cheapside, E.C. 2. P6793 A

LONDON REPRESENTATIVE REQUIRED by Firm of Stationary Semi-Diesel Crude Oil Engine Manufacturers. Applicants should have good technical experience and connection amongst Government Departments, Municipalities, District Councils and power users generally.—Address, 1415, The Engineer Office. 1415 A

REPRESENTATIVES (One Each for London, Provinces and Glasgow) WANTED by well-known Manufacturing Firm of Engineers' Photo Papers and Drawing Material Merchants. Must have the highest references, experience and connection. State full particulars in strictest confidence.—Address, P6819, The Engineer Office. P6819 A

REQUIRED for Important Railway in Argentina, ASSISTANT to CHIEF MECHANICAL ENGINEER; must have thorough Carriage and Wagon Experience in all branches. Must not be more than 35 years of age. Commencing salary £1000 p.a.—Write, giving full particulars of experience and copies (not originals) of testimonials, to Box "A.C.M.E.," c/o Davies and Co., 95, Bishopsgate, E.C. 2. 1382 A

TECHNICAL ASSISTANT to CHIEF ENGINEER REQUIRED, to carry out work in connection with Reconstruction of Iron and Steel Works. Applicants must have had large experience in modern electrically driven Iron and Steel Works, including modern Blast-furnaces, Plate Rolling Mills, &c., and be capable of dealing with general schemes, estimating and the specification of materials for ordering. State age, salary expected, and experience to SECRETARY, Consett Iron Company, Limited, Consett, Co. Durham. 1253 A

THE BRITISH REINFORCED CONCRETE ENGINEERING CO., Ltd., 1, Dickinson-street, Manchester, REQUIRE the SERVICES of TWO High-class SALESMEN, with a knowledge of Reinforced Concrete Construction, to Represent them in London and Midland Districts respectively. Travelling experience not essential, but will carry preference.—Replies, marked "Confidential," should state age, qualifications, and salary required. 1393 A

TRAVELLERS, with Connection Amongst Steam and Power Users, to Sell Plastic Packing and Jointing. Experience essential. Liberal commission.—Reply, "ALPHA 105," c/o Deacon's, Leadenhall-street, E.C. 3. 1429 A

WANTED AT ONCE for London Drawing-office, experienced LADY TRACER.—Address, giving particulars of experience, age and salary required, 1432, The Engineer Office. 1432 A

WANTED, DRAUGHTSMEN, Experienced in Water-tube Boiler Design, also for Contract and Lay-out Work. Must be able to carry out duties without unnecessary supervision.—Address, stating age, experience, and salary required, 1420, The Engineer Office. 1420 A

DRAUGHTSMAN - DESIGNER WANTED for Cold-starting Crude Oil Engines suitable for conversion to gas. Only thoroughly experienced men need apply.—Write full particulars, Box 1248, Sells' Advertising Offices, Fleet-street, E.C. 4. 1319 A

DRAUGHTSMAN REQUIRED by a Firm of Manufacturing Engineers. Must be thoroughly experienced in the Design of High-speed Air Compressors of all types, and Winding Engines, steam and electrically driven.—Address, stating age, full particulars regarding experience, and salary required, 1394, The Engineer Office. 1394 A

DRAUGHTSMAN REQUIRED IMMEDIATELY by Large Firm of Engineers and Contractors for their London office. Thoroughly experienced in Designing and Laying Out Mechanical Handling Plants for large public works contracts. Only men with first-class experience as above need write.—State experience, age, and salary required to Box 245, c/o Judd's, 87, Gresham-street, E.C. 2. 1396 A

DRAUGHTSMAN REQUIRED, with Experience in Design of Diesel or other High-compression Oil Engines. State age, experience, salary, and when at liberty.—Address, 1408, The Engineer Office. 1408 A

DRAUGHTSMAN, 25 to 35, Specialised in Hydraulic Machinery and Cranes. State fully experience, age, and salary; only qualified men need apply.—Address, 1404, The Engineer Office. 1404 A

DRAUGHTSMAN WANTED, Accustomed to Constructional work, in connection with Screens, Head Gears, and other Colliery Work. Only good men, having technical and theoretical experience, need apply. State full particulars and salary required.—Write in first instance, MANSFIELD ENGINEERING CO., Ltd., Mansfield. 1418 A

ENGINEER DRAUGHTSMAN REQUIRED; Well up in Plant Construction and Maintenance; experience of Gas Producers, Boilers, Furnaces and Electrical Equipment desirable. Good disciplinarian; age 30 to 35.—Apply, with particulars of experience and salary required, to HANS RENOLD, Ltd., Burnage Works, Didsbury, Manchester. 1401 A

ENGINEER'S DRAUGHTSMAN REQUIRED, Used to Involute and Bevel Gearing. State reference, salary, and age.—Address, 1376, The Engineer Office. 1376 A

FULLY QUALIFIED STRUCTURAL DRAUGHTSMAN REQUIRED AT ONCE for London Office. Only first-class men need apply.—Address, giving full experience, age and salary required, 1434, The Engineer Office. 1434 A

FULLY QUALIFIED DRAUGHTSMAN REQUIRED for Cranesworks; must have not less than 10 years' drawing-office experience in Crane Construction; age about 30; state full details of experience and salary required.—Address, P6823, The Engineer Office. P6823 A

SITUATIONS WANTED

WANTED, POSITION of ENGINEERING SHOP MANAGER; good organiser, with good testimonials, having held similar position with prominent engineering firms.—Address, P6824, The Engineer Office. P6824 B

ADVERTISER, a Public School Man, 34, 2 Years university, 5 years' apprenticeship, fully qualified mechanical engineer, A.M.I.M.E., REQUIRES permanent APPOINTMENT at home or abroad. Previous posts include assistant works manager, works manager; has experience in Near East; speaks French, Arabic.—Address, P6836, The Engineer Office. P6836 B

A.M.I. MECH. E., Scotch, 42, DESIRES Responsible ENGINEERING APPOINTMENT. At present London manager to association comprising number large engineering firms this country, wishes to negotiate responsible engineering appointment. Accustomed to responsibility. Extensive administration and executive experience. Good organiser with commercial experience. Personal entre to all large engineering firms this country. Excellent record. Travelled extensively, America, Canada, India. Used to handling large propositions.—Address, P6802, The Engineer Office. P6802 B

BOILER INSPECTOR.—A Practical BOILER-MAKER, age 28, DESIRES POST as Boiler Inspector or Foreman Boilermaker; well up in maintenance work, 3 years' sea service in the Navy; International Correspondence School's Diploma; blast-furnace experience.—Address, SHAW, 10, Vane-street, Stockton-on-Tees. P6830 B

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M., 613, c/o Deacon's, Leadenhall-street, E.C. 1343 B

CENTRIFUGAL PUMPING PLANT.—ENGLISHMAN, A.M.I. Mech. E., with excellent record and wide experience of design, manufacture and tests of this class of work, is OPEN for APPOINTMENT. Locality unimportant. Full particulars on request.—Address, P6813, The Engineer Office. P6813 B

CIVIL ENGINEER (24), B.Sc. (Eng.), 3½ Years' pract. exper., good surveyor and draughtsman, DESIRES SIT., waterworks, hydro-elec., or roads.—Address, P6722, The Engineer Office. P6722 B

COMPANY ENGINEER OR WORKS MANAGER.—ADVERTISER, at present holding former position, REQUIRES either POSITION in or near London. Extensive experience in marine (naval and mercantile), hydraulic, erection; specialising in patent fuel plant and machinery.—Address, P6811, The Engineer Office. P6811 B

CONSTRUCTIONAL ENGINEER (32), at Present disengaged, fully qualified, experienced in erecting all types steel structures, reinforced concrete, general works, plant and auxiliary machinery, rate fixing, drawing-office, correspondence, estimating, progress, accustomed to sole charge contracts, strict disciplinarian, highest references.—Address, C. M., c/o Firth, 11a, Prince's-square, Harrogate. 1416 B

CONSTRUCTIONAL ENGINEER.—CHIEF DESIGNER to a well-known firm DESIRES advancing POSITION offering good prospects. Wide experience of all classes of steel structures, including buildings under steel framed acts. Replies in confidence.—Address, P6787, The Engineer Office. P6787 B

ENGINEER CHIEF, All Depts. of Works Engineering, gas, elec., steam, hyd., &c., building construction, factory maintenance or production, draughtsman, at liberty in the near future, REQUIRES APPOINTMENT.—Address, P6778, The Engineer Office. P6778 B

ENGINEER, Late Manager of Small Works, SEEKS POST where 30 years' general engineering experience, organising ability tact and initiative are of value.—Address, P6829, The Engineer Office. P6829 B

ENGINEER REPRESENTATIVE, A.M.I. Mech. E., with practical and technical training, sound knowledge and experience of the French market in various branches, DESIRES to ENTER into COMMUNICATION with FIRMS desiring Representation, France, Belgium or other countries.—Address, P6768, The Engineer Office. P6768 B

ENGINEER (21) SEEKS APPOINTMENT, Desiring to go abroad; 2 years' apprenticeship, internal combustion engines; eight months improver; some steam experience; eight months drawing-office; London matriculation.—Address, P6806, The Engineer Office. P6806 B

ENGINEER (34), with Long Experience in Several branches of mechanical engineering, shops, D.O. and managerial depts., specially conversant with rotary newspaper magazine and other printing presses, good electrical exp., excellent testimonials, last post, time supervising engineer to group of five factories (large and medium sized), DESIRES APPOINTMENT.—Address, P6837, The Engineer Office. P6837 B

FOUNDRY MANAGER REQUIRES RE-ENGAGEMENT. Previously employed Sterling Metals, Ltd., Coventry; period of service 9 years; Expert in automobile and aero-engine castings; excellent references, good organiser and disciplinarian.—Address, P6840, The Engineer Office. P6840 B

GENERAL MANAGER, with Many Years' Experience with large automatic machinery manufacturing firm, is OPEN for SIMILAR APPOINTMENT. Proved administrator and business developer; highest qualifications.—Address, P6769, The Engineer Office. P6769 B

LOCOMOTIVE, CARRIAGE and WAGON ENGINEER (50), married, A.M. Inst. C.E., A.M.I. Loco. E., URGENTLY REQUIRES APPOINTMENT in England; 6 years' training in loco. shops, running sheds and drawing-office of large English railway; 7 years' experience as assistant and district loco. superintendent on Indian State Railways. High ability and initiative, keen and energetic.

Small post with prospects of recognition of merit would be accepted.

Address P6841, The Engineer Office. P6841 B

MARINE ENGINEER, 23 Years' Experience, 10 years chief, SEEKS SHORE POST, boiler and machinery surveying, maintenance, &c.—M.M., 187, care Deacon's, Leadenhall-street, E.C. 3. 1407 B

MECHANICAL ENGINEER (24), Exp. Steam, Oil, electricity, marine and automobile machinery, DESIRES POSITION at home or abroad.—Address, E. T. W., 105, Helix-road, Brixton, S.W. 2. P6823 B

MECHANICAL and ELECTRICAL ENGINEER (at present engaged) SEEKS POSITION as Assistant to Consulting Engineer. Thoroughly competent to make all tests and calculations, supervise drawings, and prepare specifications. Salary not less than £500 per annum.—Address, P6799, The Engineer Office. P6799 B

MECHANICAL ENGINEER, Englishman, Aged 27, at present in India, SEEKS POST, Charge or Erection of Mill, Pumping or other Plant, &c.; Varied experience free June, 1923.—Address, P6816, The Engineer Office. P6816 B

M.I. MECH. E. DESIRES POSITION as GENERAL MANAGER, WORKS MANAGER, REPRESENTATIVE, or other responsible post at home or abroad. Bachelor; speaks French fluently; exceptional experience of mass production methods; over 14 years in executive positions with large firm engaged on accurate interchangeable work, with control of offices and works. Also recent experience in textile machinery and general engineering in France. Tactful and successful in dealings with workspeople. Business capacity and commercial experience.

Salary £500 per annum.

Address, P6797, The Engineer Office. P6797 B

SITUATIONS WANTED (continued)

PRODUCTION ENGINEER (42), Life Experience in U.S.A. and England, production and cost systems, capable of entire charge, SEEKS CHANGE.—Address, P6831, The Engineer Office. P6831 B

TWO FIRMS REQUIRING REPRESENTATIVE or WISHING to EXTEND PRESENT BUSINESS in INDIA and FAR EAST.—ENGINEER (33), accustomed responsibility and hard work, returning from India April, 1923, DESIRES NEGOTIATE ENGAGEMENT as Branch Manager or Assistant; 16 years' experience manufacturing, maintenance, purchasing, sales, all classes engineering machinery and appliances, well educated, good address, capable taking charge sales or manufacturing side, well up shipping accounts, correspondence, publicity, highest references; willing to travel.—Address, P6747, The Engineer Office. P6747 B

TO PUBLIC WORKS CONTRACTORS AND CONSTRUCTIONAL ENGINEERS.—CIVIL ENGINEER (29), A.C.G.I., A.M.I.C.E., ex-officer, 10 years' experience public works, India, SEEKS EMPLOYMENT at home in any suitable capacity; small salary accepted to start.—Address, P6835, The Engineer Office. P6835 B

TRAINED ENGINEER, Electrical and Mechanical, with extensive experience in industrial plant lay-out and equipment, SEEKS POSITION as London Representative of good firm.—Address, P6800, The Engineer Office. P6800 B

WATER POWER.—ENGINEER, Public School and Imperial College, A.C.G.I., A.M.I.C.E., A.M.I.E.E., experienced in laying out and tendering hydro-electric installations, SEEKS a responsible POSITION with Consulting Engineers or Manufacturers.—Address, P6809, The Engineer Office. P6809 B

YOUNG MAN, Age 30, DESIRES EMPLOY.; Exp., 7½ yrs. works and D.O. with large rly. wks., 2½ yrs. hand cranes and mechanical structure design, 3½ yrs. motor and aircraft mech. and gen. mech. design.—Address, P6807, The Engineer Office. P6807 B

YOUNG MAN (28), Civil Engineer, College Trained, SEEKS any suitable POSITION in Drawing-office of Civil Engineer or Structural Engineering Firm. Low salary for commencement.—Address, P6817, The Engineer Office. P6817 B

CHIEF DRAUGHTSMAN (Machine Tools), 25 Years' experience, REQUIRES similar POSITION or Manager; good organiser, successful control of labour.—Address, P6812, The Engineer Office. P6812 B

DRAUGHTSMAN SEEKS SITUATION, 3 Years' shop and 6 years' drawing-office experience; acquainted with paper mill machinery.—No. 8,517, Keith and Co., Edinburgh. P6825 B

ENGINEER DRAUGHTSMAN, Mechanical Structural, designing, calculating, detailing, estimating and general office routine, 4 yrs. works, 8 yrs. D.O., home and abroad, REQUIRES POSITION, Assistant to Consulting Engineer or in Structural Office. Excellent references; moderate salary to start.—Address, P6810, The Engineer Office. P6810 B

EXPERT TRACER, Young Lady (23), REQUIRES POST as seven years' experience; good knowledge also of shorthand and typewriting; specimen drawings submitted if desired.—Address, P6814, The Engineer Office. P6814 B

JUNIOR DRAUGHTSMAN, Mechanical and Structural, accustomed to machine details and gas-works plant, technically trained, best references, disengaged, SEEKS SITUATION.—Address, P6798, The Engineer Office. P6798 B

MECHANICAL DRAUGHTSMAN (27) SEEKS POST with General Engineering Firm, London district; disabled ex-Service man. Interview solicited.—Address, P6827, The Engineer Office. P6827 B

FOUNDRY FOREMAN, Fifteen Years' Experience as foreman, OPEN to ENGAGEMENT; used to various classes of work in green dry sand and loam, also several years' experience of machine-moulded gears of all descriptions.—Address, P6815, The Engineer Office. P6815 B

MACHINE SHOP FOREMAN (37) SEEKS BERTH. Twelve years' experience successful managing shops on general and repetition work; up-to-date methods, well up in labour-saving devices; London.—Address, P6795, The Engineer Office. P6795 B

STOREKEEPER (Experienced) SEEKS an Early ENGAGEMENT; good organiser, capable of taking control and management of all stores depts.—Address, P6808, The Engineer Office. P6808 B

PARTNERSHIPS

ENGINEERING PARTNERSHIPS AND BUSINESSES.

Wheatley Kirk, Price & Co.,

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Established seventy years.

OPENING Occurs for Enterprising YOUNG ENGINEER with £500 to £750 capital (fully secured), to manage new works (Birmingham). Large and profitable orders on hand. Bankers' references exchanged.—Address, P6838, The Engineer Office. P6838 C

PARTNERSHIPS, DIRECTORSHIPS WANTED for not less than £2000. Businesses must be well established. £2000, £4000, £5000 and £10,000 available. January list of investors sent. Calls preferred.—OFFICERS' PARTNERSHIP GUARDIAN, Limited, 48, Dover-street, W. 1. 1388 C

PARTNERSHIPS and ACTIVE DIRECTORSHIPS WANTED in Mechanical, Constructional, Electrical Engineers, &c., for Clients with technical experience and capital from £1000 to £20,000.—GILBERT and PRATT, 18, Walbrook, London, E.C. 4. EX C

MACHINERY, &c., WANTED

WANTED, a 3-TON STEAM TRAVELLING CRANE, lift 22 to 25ft.; Thomas Smith preferred.—Address, 1391, The Engineer Office. 1391 F

WANTED IMMEDIATELY, SECOND-HAND LATHE in good condition, 12 to 16in. centres, straight bed, to take 20ft. between centres, sliding, surfacing, screw-cutting not essential.—Address, 1392, The Engineer Office. 1392 F

WANTED, New or Second-hand ANGLE BENDING MACHINE, to take up to 4in. by 5-8in. thick. Also MULTIPLE PUNCHING MACHINE, to take 1-8in. plates and upwards, and to punch all size of holes.—Address, 1424, The Engineer Office. 1424 F

WANTED to PURCHASE, HYDRAULIC PUMP for working pressure of 21-3 tons per square inch, either for hand or power driving. State condition and maker.—Address, 1419, The Engineer Office. 1419 F

For continuation of Small Advertisements see page 3.

JANUARY.

Grouping the Railways.

THE opening of the New Year saw the twenty principal railway companies, except the Caledonian, grouped into four, in accordance with the Railways Act, 1921. The Act called also for ninety-three subsidiary companies to be absorbed. There has not, however, been much hurry over the minor companies, as, although the Amalgamation Tribunal has now to prepare the scheme for any absorption not agreed to by January 1st, the smaller companies are at the mercy of the groups. Therefore, instead of about one hundred and twenty companies disappearing on the 1st of the month, only sixty-two were absorbed, and there remained one constituent company—the Caledonian—and about fifty subsidiary companies to be disposed of; some of the latter have since been dealt with. This reorganisation has led to the retirement of some well-known railway chiefs. Among them are Sir Sam Fay—who will find congenial occupation, among other new interests, in the chairmanship of Beyer, Peacock's—Mr. Frank Tatlow, of the Midland, and Mr. David Cooper, of the Glasgow and South-Western; the last-named was the *doyen* of the general managers. Included in the chief engineers who have retired are Mr. James Briggs, of the Midland, and Mr. W. A. Paterson, of the Caledonian. Sir Vincent Raven has retired, but has been retained as the technical adviser of the London and North-Eastern Railway, and whilst we have seen no intimation to that effect, we believe that Mr. J. G. Robinson has also left. Among the changes in what is generally called the traffic side we note especially the retirement of Mr. L. W. Horne from the London and North-Western.

Trade Improving.

EVERYONE is agreed that trade is improving, but it is not always easy to lay one's finger on examples that support that view. It is pleasant, therefore, to be able to record that several important contracts were placed during the month. Of them, the most notable is the order received by C. A. Parsons and Co. from the Commonwealth Edison Company, of Chicago, for a 40,000-kilowatt turbo-alternator. There are French machines of the same capacity in the Gennevilliers power station, but we believe this will be the first alternator of its size to be built in England. Another interesting contract is that secured by Gwynnes Engineering Company, Limited, from the London County Council. It is for five gas-driven centrifugal pumping engines, which are to be erected at Hammersmith to deal with 1000 tons of storm water per minute. Gwynnes have also contracted to build for the Council three triple-expansion steam engines driving 30in. centrifugal pumps and two smaller engines, all for the Abbey Mills sewage pumping station. One other order of appreciable magnitude may be mentioned, namely, that taken by Robert Hudson, Limited. It covers something like one hundred thousand tons of steel railway material of various kinds for Africa. Such contracts as these, small as they may be in contrast with the country's needs, do at least show pretty clearly that affairs are moving in the right direction, and give some sound cause for believing that the prolonged depression is passing away.

Scientific Research.

THE efforts to encourage research and invention through the semi-State Committee at Bellevue, which the French Government instituted as a continuation of the Inventions Committee created during the war, have not given the results expected of them. The Bellevue organisation has, indeed, been violently attacked by inventors themselves, some of whom affect an entire disbelief in the disinterestedness of the Committee. In any case the Bellevue laboratory possesses very limited means for carrying out experimental work, and it was superseded during the month by the creation of a National Office of Scientific and Industrial Research and Invention. As is the case with all these national institutions, in which it is sought to combine the interests of every class of the community, the constitution is complicated and the organisation unwieldy. It will have a national council and an administrative council, the former consisting of 145 members, including senators, deputies, members of the Academy of Sciences, members of all the great educational institutions and representatives of industrial and agricultural groups and of the working classes. Its main object is to carry out research work on behalf of public services and to provide subsidies for private work of investigation and for the creation of laboratories and, in a word, to do everything for the encouragement of research and invention. By merely endowing laboratories the National Office will be rendering a valuable service, for the scientific institutions in France probably lag behind all others in the equipment of laboratories, and in the circumstances it is surprising how much valuable research work is done.

A New Chemical Element.

THE announcement of the definite detection of a new chemical element, hafnium—to give it the name proposed for it by its discoverers, MM. Coster and Hevesy, of Copenhagen—aroused great interest in scientific circles during the month. This element had been long sought for, and indeed as far back as 1895 Thomsen, of Copenhagen, forecast its probable properties and indicated where it was likely to be discovered. Last year two French scientists claimed to have detected it in a mixture of rare earth metals, but, according to the Danish investigators, their deductions were at fault. The element, they held, could not be a rare earth, but must, in accordance with Thomsen's forecast, be homologous to zirconium. Applying Moseley's method of investigation, involving the measurement of the wave lengths of X-ray emissions, they obtained from extractions of zirconium minerals, spectra corresponding to that required for the missing element of atomic number 72 in Moseley's classification. As much as 1 per cent. of the new element was indicated as being present in a certain sample of Norwegian zirconium mineral, while in ordinary zirconium the amount, it is believed, may be from 0.01 to 0.1 per cent. The new element has been detected, but not as yet isolated. Experiments, however, are proceeding towards that end, and for the determination of the chemical properties of the substance. It comes between lutecium of atomic weight 174 and tantalum of atomic weight 181. It is the fifth new element to be added to the list since the opening of this century, the others being europium, discovered by Demarçay in 1901; radium, by the Curies in 1902; dysprosium, by Urbain and Demenitroux in 1907; and lutecium, by Urbain in 1908. It is a curious fact that five new elements were discovered in each of the three decades between 1870 and 1900.

Power Alcohol.

THE use of alcohol as a motor fuel in France is to be rendered compulsory by a Bill which has just been voted in the Chamber of Deputies without discussion and will be promulgated immediately it has passed through the Senate. Apart from any question of national economy in restricting the importation of petrol, the measure has become particularly urgent on account of the enormous accumulation of alcohol since the State secured a monopoly of the buying and selling of spirit other than that distilled from fruit and grapes and employed for human consumption. As the production of alcohol from grain and beet is equivalent to about one-tenth of the quantity of petrol imported, and as experiments have proved that an admixture of 10 per cent. alcohol to petrol provides an excellent fuel, the Bill just voted requires importers of petrol, benzol, benzine, toluene and other mineral spirits to purchase from the State a quantity of alcohol sufficient to make a 10 per cent. mixture. The State is empowered to fix the percentage according to circumstances, as well as the price, this being done to ensure that the composite fuel will not be sold at a higher price than petrol. The powers provided by the Bill give the State great latitude in the way of imposing a "national fuel" of a character that research and experiment may prove to be the most favourable to the home production.

The Treatment of Oily Ballast Water.

THE legislation provided by the Oil in Navigable Waters Act, 1922, which came into force at the beginning of the month, is certainly to be welcomed as a measure guarding the waters of harbours and coastal seas against pollution by oily effluents. The problem of dealing effectively with oily residues and ballast waters has been insistent ever since the introduction of oil fuel for marine use, and many cases are familiar in which, in the neighbourhood of naval bases, harbours and mercantile bunkering stations, much damage and discomfort have been caused by oily deposits. Under the new Act it has become a penal offence to discharge oil or allow oil to escape into the sea within the three-mile limit from the shore. Means of overcoming the necessity of proceeding to sea to discharge and wash out ballast and oil tanks have been provided by designing a special barge with apparatus to separate the oil from the water. The barge designed for this purpose by Smith's Dock Company, Limited, of South Shields, in conjunction with the Anglo-Saxon Petroleum Company, Limited, was described in detail in our last issue. The separation of the oil and water is effected by means of a cone separator in conjunction with a series of cascade filters. Pumping machinery and heating appliances form part of the equipment, and the necessary steam is provided by the vessel which is being served. A 250-ton barge is able to deal with oily ballast water discharged at the rate of 180 to 200 tons per hour, and we are given to understand that, in addition to two barges on order for the Port of London Authority, barges are to be constructed for both the Liverpool and Tyne Harbour Authorities.

Agricultural Machinery.

THE situation revealed by the show of agricultural implements and machinery in Paris during the month was typical of what is taking place in many other branches of industry where the French have been able to profit from the discrepancy of the exchange rate to develop a manufacturing business at the expense of foreign firms. The magnitude of the French exhibits left no doubt that, except in harvesting machinery, makers in that country are now able to supply nearly everything that is required, and they have even succeeded in developing an export trade. Seeing, however, that this business has been built up on the unstable foundation of a depreciated currency, it is by no means certain that makers will be in a sound position for meeting foreign competition when the exchange discrepancy is less marked than it is at present. Notwithstanding the disadvantage of having to adjust their prices to a fluctuating French currency some British firms are still doing business, although if the depreciation of the franc should continue, a point will certainly be reached when foreign makers will have to retire from the field for the time being. In a general way, however, the rapid advance in French manufacturing costs is placing makers on the other side of the Channel in such a position that any considerable improvement in currency values will bring about a complete reversal of the existing state of things by enabling British goods to be sold in France at below the prices of similar articles manufactured in the country. The economic troubles caused by the Ruhr occupation will certainly accentuate the difficulty of doing business with France for some time to come, but they will at the same time still further raise manufacturing costs, owing to inflated values and higher wages, and a subsequent rapid appreciation of the franc will immediately open the market to British goods.

Six Railway Accident Reports.

FROM November 15th last to the 13th of the month there was the unusually long interval of practically two months without any railway accident reports being issued. This evidently was not due to no accidents having been inquired into, as since the latter date six reports have been published. They relate to the following mishaps. On October 7th one of the signalmen in Clyde Junction box, St. Enochs Station, Glasgow, threw up the signal in the face of the driver of a passenger train and reversed the road so that the train came into collision with a light engine which was standing foul. On October 26th the signalman at Reddish, London and North-Western Railway, completely forgot a light engine which was approaching him. He saw the block instrument indicating "train on line," but thought that it was for a goods train that had passed ten minutes previously. So he "cleared" the line and, two minutes later, accepted another goods train, which ran into the light engine. Four days later, near Walkden water troughs on the same system, the leading bogie of the first coach and the leading wheels of the tender of an express from Blackpool to Manchester were derailed owing to a fractured rail. On November 13th, during a fog, an L.B.S.C.R. train was derailed near Croydon, and on the next day the driver of an empty carriage train passed a signal at danger in a fog at Wood Green, with the result that his train ran into the up day East Coast Scotch express outside Hornsey. Two days later, at Retford, on the G.N.R., also in a fog, a second passenger train, owing to irregular block working, was admitted into the station without any warning as to the first train being there. In none of the cases were there any serious personal injuries. In the first and fourth automatic train control was suggested as a remedy.

Commercial Propaganda.

PUBLICITY is more than ever necessary to secure business, not only by individual firms, but also

by collective industries, and of late there has been a tendency to give greater publicity to a country's resources by means of State organised travelling exhibits. The three French cruisers which are now carrying samples of manufactured and other products half round the world and which, during the month, met with an enthusiastic reception in Australian ports, appear to have achieved results that already justify the experiment. The cost involved is small in view of the fact that the ships must be, in any case, in service. Now another original form of commercial propaganda is to be carried out by Canada, which has had a particularly varied experience in the organisation and management of collective exhibits, and by arrangement with the French Government thirty motor wagons are to tour France with samples of Canadian products and everything necessary to impress upon the French the interest and extent of the Dominion's resources. The motor vehicles will be supplied by the French Government, which will also provide accommodation for the staff. The caravan will visit all the big centres and will be installed in the Tuileries Gardens during its stay in Paris, while its visit to Bordeaux will coincide with the holding of the annual Fair. The idea of the French and Canadian publicity campaigns is to leave a lasting impression in other countries of national productive resources which will directly help business with individual firms, but while commercial cruisers and motor caravans may be satisfactory means of attaining this end, it is by no means certain that the permanent results will be better than those achieved through existing properly directed channels of publicity.

The Electric Drive in Auxiliary Naval Vessels.

ALTHOUGH the United States have, alone amongst countries, so far, adopted the system of electrical transmission for large warships, this method of propulsion seems to be coming into favour for vessels designed for auxiliary naval purposes, two such ships having been completed last year—one for Holland and the other for Japan.

THE PELIKAAN.

The first is the Pelikaan, a depôt ship for submarines, destined for service in the Netherlands East Indies. She was built for the Royal Dutch Navy at the Amsterdam yard of the Netherlands Shipbuilding Company, through the courtesy of which we are enabled to describe and illustrate her.

FIG. 1—OFFICERS' WARDROOM ON THE PELIKAAN

The chief dimensions of the Pelikaan, a view of which is given in Fig. 3, are: Length overall, 307ft. 2in.; breadth, 42ft. 7in.; depth, 27ft. 2in.; draught, 13ft. 2in.; displacement, approximately 2487 tons. The Kon. My. "De Schelde," of Flushing, was responsible for the machinery installation, the main engines having been supplied by the Maschinenfabrik Augsburg-Nürnberg, and the electric motors and dynamos by the Electrotechnische Industrie, of Slikkerveer, Holland. The internal arrangement of the Pelikaan is such as to provide quarters for the officers and men of four submarines, in addition to her own complement. There are also a large workshop and storage space for the equipment and accessories of six submarines. The commanding officer's quarters, situated on the awning deck, comprise a sitting-room, a sleeping cabin, pantry, bath, and toilet. Cabins are provided on the same deck for the first officers and the commanders of three submarines. The other officers are berthed in single or double cabins on the upper deck and the second 'tween deck. The spacious and pleasant wardroom is on the upper deck—see Fig. 1. The petty officers and men are divided into two groups, Europeans and natives, the two groups having separate accommodation. The European petty officers have a large mess room on the first 'tween deck and cabins on the deck below; the native petty officers have their own mess room on the first 'tween deck and cabins on the second. On the same decks the European and native seamen are accommodated. There are, further, a sick bay with twelve cots, an operating theatre, a dispensary, bath, and water-closet. The ship has two complete refrigerating plants, each capable of producing 330 lb. of ice per twenty-four hours; a refrigerating room, and several ice lockers. This plant is also utilised to maintain the magazines at the correct temperature. Besides the magnetic compasses, there is a complete gyro-compass installation. The wireless equipment is powerful and up-to-date, and has a sending range of 2500 miles. Submarine signalling apparatus and electro-hydraulic steering gear with telemotor are fitted.

As the ship is intended to serve as a floating repair shop for submarines, an unusually large amount of space is taken up by the store rooms and repair plant. The torpedo workshop is furnished with a number of modern machine tools. On the first 'tween deck is a repair shop for submarine accumulators, ventilated by electric fans. The store rooms contain diving gear, spare parts for submarines, sulphuric acid, and distilled water, both in bottles and tanks. In the oxygen store room is kept a battery of twenty-four cylinders of compressed oxygen, the contents of which can be transferred by means of a special pump into the oxygen cylinders of submarines lying alongside the parent ship. In this room are also stored seventy-two cylinders of compressed carbonic acid. As the ship is designed to carry two seaplanes, an electric winch and a derrick swung from the main mast are fitted for hoisting these machines in and out. Three tanks of benzine are stored for the use of the seaplanes and the ship's motor boats. As a battery of cylinders containing compressed carbonic acid is kept on the first 'tween deck, the room in which the benzine tanks are stored can be filled with this gas in case there is danger of fire. The stem of the ship is of peculiar form, as it is intended to serve the purpose of hoisting burdens up to 40 tons by means of an electric winch on the bridge deck, just before the foremast. Another electric winch is placed before the main mast for hoisting the boats in and out. There are two windlasses, both worked by electricity, on the upper deck aft, and a third on the forecastle. The armament consists of four 75 mm. anti-aircraft guns, mounted on deck, and four machine guns. Each mast carries a searchlight.

The ship is propelled by two main 6-cylinder Diesel engines of 700 horse-power, each driving a continuous-current dynamo of 468-kilowatts, 1200 ampères, 390 volts—see Fig. 4, page 122—which supply current to the propeller motors and torpedo air pumps, and for charging the batteries of submarines. These main motors are continuous-current units of 570 shaft horse-power, 380 volts, 1200 ampères, running at 190 revolutions per minute, and each turning a three-bladed propeller—see Fig. 5, page 122. The main switchboard is placed on the port side of the engine-room. Both dynamos can drive either propeller motor, or, alternatively, one dynamo can simultaneously drive both motors. For operating the winches, the steering-gear motor, the motor for driving the machine tools in the repair shop, the converters, and the lighting plant, two compound, continuous-current dynamos of 32 kilowatts, at 220 volts, are placed in the engine-room, coupled to a 50 horse-power Diesel engine. The auxiliary machinery switchboard is fitted on the starboard side of the engine-room. On the awning deck there is a dynamo, driven by a 25 horse-power Kromhout engine, as a spare installation for emergency lighting and for working the boat winch. To empty the holds in case of danger an emergency bilge pump, which is connected to the main bilge piping of the ship, is situated on the second 'tween deck in the vicinity of the refrigerating room. Having completed her trials successfully, the Pelikaan, we understand, has left for her station in the Dutch East Indies.

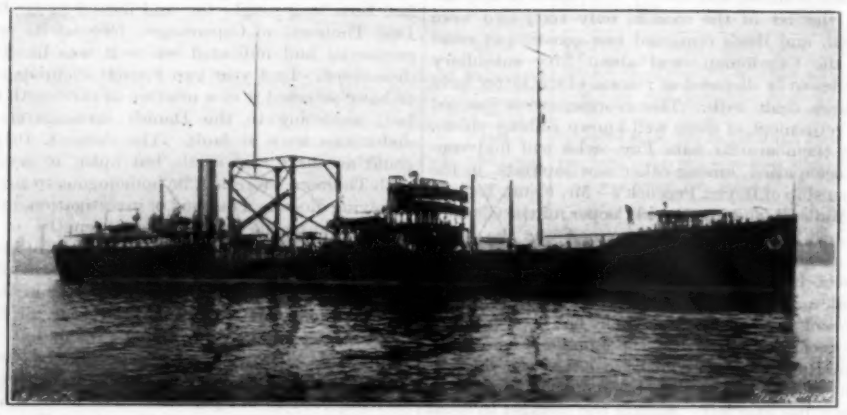

FIG. 2—THE JAPANESE NAVAL OIL TANKER KAMOI

THE KAMOI.

The second vessel referred to is the Kamoi—see Fig. 2—an oil tanker and fleet collier for the Imperial Japanese Navy, built by the New York Shipbuilding Company, at Camden, N.J., and completed in September last. Her principal dimensions are:—Length on waterline, 495ft.; breadth, 62ft.; normal draught, 28ft.; tonnage, 13,000 tons deadweight. The oil fuel carrying capacity is about 10,000 tons. The propelling machinery consists of an 8000 horse-power Curtis turbine generator, supplying power to two 4000 horse-power synchronous motors directly driving the twin propellers. Two 400-kilowatt direct-current turbine generators are fitted for supplying the excitation current, as well as power for the auxiliary machinery, viz., the main circulation pump, main condenser pump, sanitary pump, blower motors, steering gear, wireless apparatus and ventilating and lighting equipment. There is, further, a 625-kilowatt auxiliary alternator for connecting to either of the auxiliary turbines in the event of failure on the part of the main propulsion unit or any item of the auxiliary machinery. This small generator is capable of supplying power to drive the ship at a speed of 7 knots. Steam is generated by four Yarrow-type boilers burning coal, but fitted with oil sprays to accelerate combustion when desired. The wireless equipment, furnished by the General Electric Company, comprises a 1-kilowatt telephone and telegraph transmitter and two complete receiving sets, with wave length ranges varying respectively from 250 m. to 3000 m. and 250 m. to 30,000 m. From the wireless cabin five extensions are led to the captain's cabin, the engine-room, and other parts of the ship, enabling telephone conversation to be carried on with another vessel

DUTCH DIESEL-ELECTRIC DEPOT SHIP PELIKAAN

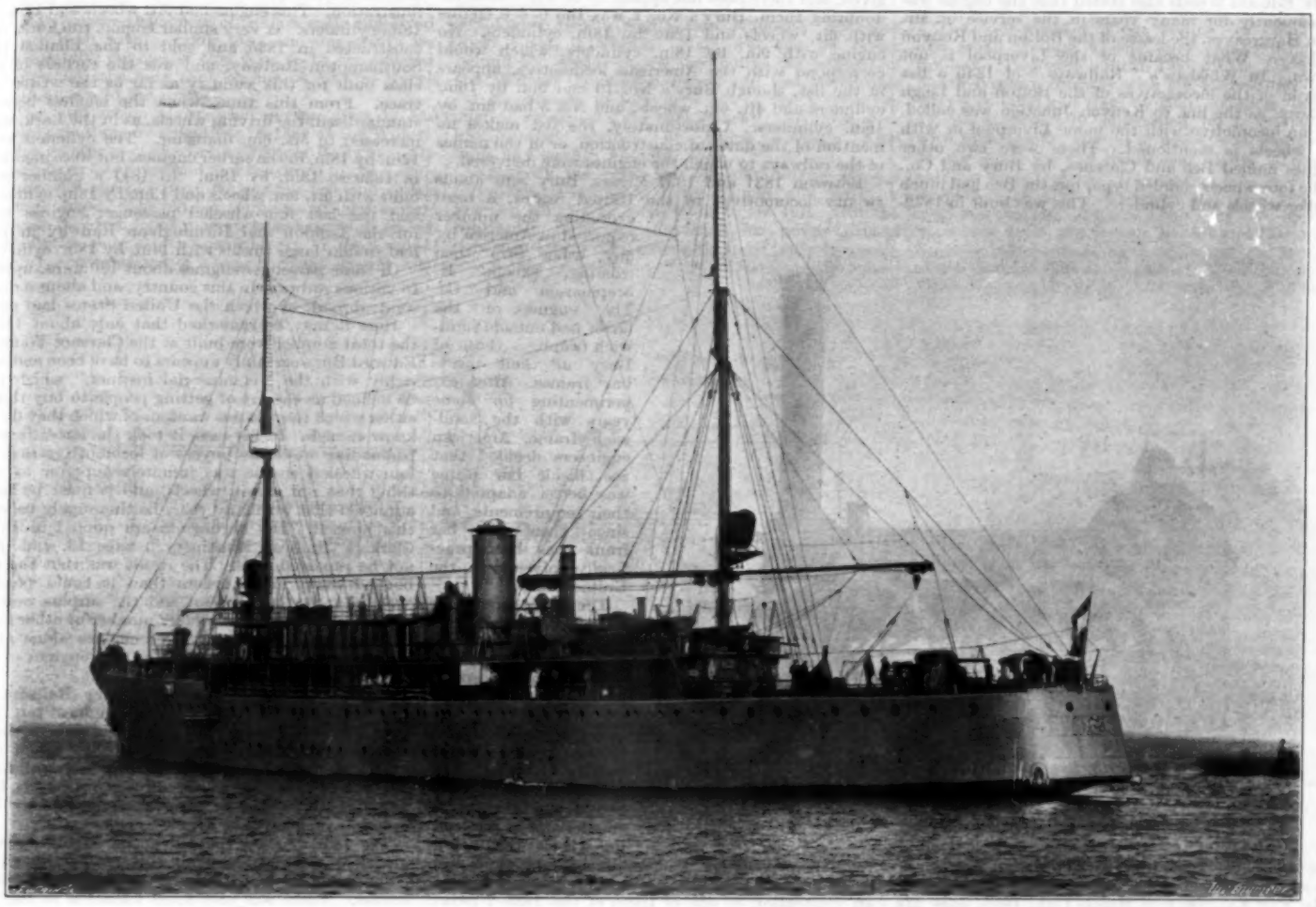

FIG. 3

from any one of these stations in the ship. The builders' trials, which were held off the Delaware Capes, are reported to have been most satisfactory. Every possible test was applied to the ship, her machinery, and equipment without bringing to light any sign of weakness. The electric drive is said to give unusual flexibility of control and to be very economical in operation. The vibration was so negligible that it was found possible to balance a coin on edge on the foundation of the main turbine while the vessel was under way. Running ahead at full speed the propelling machinery was reversed to one-quarter astern in 19 seconds, the engines then being brought up to full speed astern. A speed of approximately 15 knots is understood to have been attained. The Kamoi has since been navigated out to the Far East by a Japanese complement. In service she will be armed with two 5.5in. guns on raised platforms at bow and stern, and two anti-aircraft guns on each side abreast the funnel. The ship has a straight stem and a cruiser stern.

Short Histories of Famous Firms.

Contributed by E. L. AHRONS, M.I. Mech. E.

No. XVI.*

MESSRS. EDWARD BURY AND CO. (AFTERWARDS BURY, CURTIS AND KENNEDY), CLARENCE FOUNDRY, LIVERPOOL.

WHEN Edward Bury founded his famous firm in Liverpool does not appear to be known exactly, but that it was in existence as a general engineering shop for some years before the building of the first locomotive was begun in 1829 is certain. The construction of the Liverpool and Manchester Railway appears to have given him the idea that the manufacture of locomotives could with advantage be added to the work on which his factory was employed, and subsequently their construction gradually superseded the general and machine work.

The earliest locomotive built by Mr. Bury was a six wheels coupled engine named Dreadnought, the construction of which was begun in 1829. No authentic illustrations or dimensions of this engine are known to exist, but from the description it would appear to have been modelled to some extent upon the practice of Stephenson and Hackworth, in that a return-flue boiler was used, but the outside inclined cylinders were connected to an independent driving shaft, to the cranks of which the coupling rods were also attached. The Dreadnought was a complete failure. It was stated to have been tried by the contractor on the Liverpool and Manchester Railway, but was too heavy for the rails, and also proved very unsteady in service. It is probable that defective permanent way and light rails had something to do with the trouble. It was also stated that the outside crank pins of the driving shaft frequently broke. Mr. Bury is supposed to have subsequently modified the engine by lowering the cylinders and readjusting the weight distribution, but further trials on the Liverpool and Manchester Railway again resulted in failure. The Dreadnought was then taken back to Bury's works and scrapped.

The writer submits the above account of the Dreadnought with a note of caution, since some of the published descriptions of the engine are of very doubtful authenticity. D. K. Clark merely mentions it in "Railway Machinery," page 8, and adds that it was tried on the Liverpool and Manchester Railway on March 12th, 1830.

Bury's chief works manager was James Kennedy, who had been trained at George Stephenson's Newcastle factory, and assisted in the designs of the early Stockton and Darlington engine of 1824. Whether Kennedy had anything to do with the design of the Dreadnought the writer cannot trace. But before the Dreadnought had been put to work in 1830, Bury and Kennedy had in October, 1829 (according to a paper read by the former in 1840 before the Institution of Civil Engineers) begun the construction of another type of engine, the Liverpool, which was the first of Bury's celebrated four-wheeled engines with bar frames and inside cylinders. Colburn, in "Locomotive Engineering and Mechanism of Railways," page 31, gives the credit of the design to Kennedy, possibly because the latter had stated that the plan of constructing locomotives with crank axles and nearly horizontal cylinders was contrived and introduced by him ("Proceedings," Inst. C.E., vol. 16). As Bury was known to be an excellent draughtsman and made some of the early drawings of the firm himself, it is probable that the Liverpool was the joint work of both engineers.

With regard to Kennedy's claim that the Liverpool was the first engine to be designed with inside horizontal cylinders and a crank axle, Colburn makes the same claim for the Stockton and Darlington engine Globe, which was designed by Timothy Hackworth and built at Stephenson's factory. Hackworth's drawings were handed to Stephenson's firm on March 3rd, 1830; but, according to Bury's statement quoted above, the Liverpool was begun in October, 1829, and started work on July 22nd, 1830, long before Hackworth's Globe. Colburn states that the latter was not delivered to the Stockton and Darlington Railway until after Messrs. Stephenson had embodied its arrangement of cylinders and driving axle in the Planet for the Liverpool and Manchester Railway, which left the Newcastle works on September 3rd, 1830. But Robert Stephenson himself ("Proceedings," Inst. C.E., vol. 16) pointed out that neither Kennedy, Hackworth, nor his own firm could claim credit for the crank axle, since it was embodied in Braithwaite and Ericsson's Novelty of 1829, though that engine had vertical cylinders.

The writer is aware that locomotive history, possibly more than any other history, has frequently been productive of nearly as much literary partisan pugnacity as have political differences, and therefore he humbly hopes that the above comments will not draw upon him an excessive amount of anathema from those who hold different views.

The Liverpool was certainly in many respects a remarkable engine for the period when it was constructed. The four-coupled wheels had the large diameter of 6ft., and it was a good many years later before any other locomotives with wheels as large as this were constructed. As shown in Fig. 1, it embodied the well-known bar framing. The cylinders, 12in. by 18in., were inclined slightly upwards to allow the piston-rods to pass underneath the leading axle. The latter feature was embodied in all Bury's coupled engines for many years subsequently, and was afterwards copied by several other well-known firms in their designs for coupled locomotives. The illustration, Fig. 1, is from a photograph of an original drawing made by Edward Bury himself, but it would appear that as first constructed the engine differed from the illustration in several material points. The original boiler contained a number of convoluted flues and the fire was urged by a bellows worked from beneath the tender. The late Mr. Edward Woods described the engine—"Proceedings," Inst. C.E., vol. 16) as one in which the hand gearing was placed in front of the smoke-box where the driver stood, the stoker being in the usual position at the fire-box end. It is obvious that Fig. 1 cannot correspond to this description, for an ordinary driver's regulator handle is shown on the fire-box. Mr. Edward Woods was then connected with the old Liverpool and Manchester Railway, on which he would have every opportunity of seeing and studying the Liverpool. He added that the engine was not purchased by the railway company, which was probably not satisfied with its construction or performances. It was transferred to the branch colliery line from Kenyon Junction to Bolton, where it met with an accident. It was then thoroughly repaired at Bury's works, and the boiler appears to have been completely altered

* No. XV. appeared December 1st, 1922.

to the multitubular type. It is, therefore, probable that Bury's drawing, from which Fig. 1 has been made, shows the engine after these alterations.†

Mr. Edward Woods also stated that the engine was subsequently for many years in the service of Mr. John Hargreaves, the lessee of the Bolton and Kenyon Railway. What became of the Liverpool is not known. In Whishaw's "Railways" of 1840 a list is given of the locomotives of the Bolton and Leigh Railway, as the line to Kenyon Junction was called, and no locomotive with the name Liverpool or with 6ft. wheels is mentioned. There were two other engines named Bee and Clarence, by Bury and Co., of the four wheels coupled type, but the Bee had much smaller wheels and cylinders. This was built in 1832.

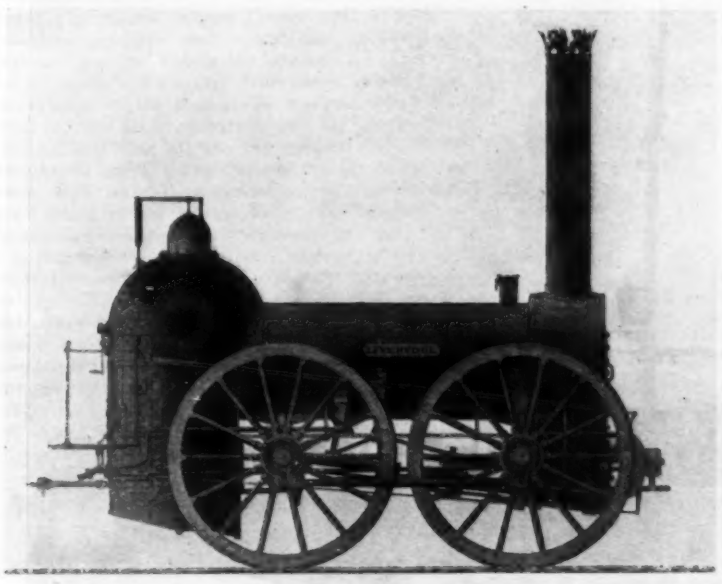

FIG. 1—THE LIVERPOOL ENGINE OF 1829

The Clarence, according to Whishaw, was a six-wheeled engine.

In THE ENGINEER of March 11th, 1898, page 226, there appeared under the heading of "Locomotives supplied by British Firms to American Railroads," an illustration purporting to represent Bury's No. 2 engine Liverpool, which was exported in 1831 to America for the Petersburg Railroad. This engine was stated to have had four-coupled wheels 4ft. 6in. diameter and cylinders 9in. by 18in. It worked with steam of 50 lb. pressure, but the lock valve was set to blow off at 60 lb.

The present writer ventures to doubt the accuracy of some of the statements contained in that article. Following the unfortunate Dreadnought, the second locomotive built by the firm was the one with 6ft. wheels, previously mentioned, which afterwards worked on the Kenyon and Bolton Railway in Lancashire. If the Dreadnought was No. 1 of Bury's construction, the American engine was certainly not No. 2. It is, however, possible that the Dreadnought may not have been included in Bury's official list, in which case the 6ft. Liverpool may have been recorded as Bury's No. 1, and only on this assumption can the American engine have been the official No. 2. But the illustration shows certain details which point to Bury's later designs of the 1835–7 period. The article states that the illustration is from the original, signed by E. Bury, which is now in the Field Museum at Chicago. There may be an original drawing by Bury at Chicago, but if the illustration in THE ENGINEER is a copy of it, it seems fairly certain that it does not represent the 1831 engine. The story goes on to say that Bury wrote to the officials of the American railway, asking to be informed as to any defects, "as it is the first engine I have constructed of this design." The preceding engine, Liverpool, with 6ft. wheels differed from the general design of the American engine in so few essential particulars, these being chiefly in the dimensions, that the sentence quoted has an apocryphal flavour, though it is naturally extremely probable that inquiries as to its behaviour were made. Then the story continues that the engine seems to have earned for itself the nickname of "Spitfire," owing to "its generous distribution of sparks along the road." This latter statement is possibly true, but unfortunately it does not square with the illustration accompanying it, for the copy of the "original drawing signed by E. Bury" shows an engine provided with a most efficient-looking wire spark arrester at the top of the chimney, which, though it might allow a few small sparks to pass, was certainly proof against any "generous distribution along the road." The writer of the article evidently overlooked that spark arrester. Or possibly the Field Museum authorities may have picked up an "Old Master."

Further, in THE ENGINEER of September 18th, 1857, there appeared a letter signed "J. T. G.," which gave the general dimensions of all Bury's early locomotives, Nos. 2 to 19. From the particulars given, and there does not appear to be any reason for doubting them, Bury's No. 2 was the 0–4–0 engine with 6ft. wheels and 12in. by 18in. cylinders. No engine with 9in. by 18in. cylinders, which would correspond with the American locomotive, appears in the list, though Bury's No. 10 had 9in. by 16in. cylinders and 4ft. 6in. wheels, and No. 5 had 8in. by 16in. cylinders. Unfortunately, the list makes no mention of the dates of construction, or of the names of the railways to which the engines were delivered.

Between 1831 and 1837 Messrs. Bury sent about twenty locomotives to the United States, a total exceeding the number exported to America by any other firm then existing, except R. Stephenson and Co. The engines of the latter had outside sandwich framng; those of Bury all had inside bar frames. After experimenting for some years with the sandwich frame, American engineers decided that the inside bar frame was better adapted to their requirements, and since then the bar frame has been practically universal in the United States.

The passenger engines built by the firm were also four wheeled, the uncoupled driving wheels being placed immediately in front of the fire-box, which was also of the semi-circular pattern shown in Fig. 1. The inside cylinders were horizontal, and owing to the smaller size of the leading wheels the piston-rods passed above the leading axle. It is unnecessary to illustrate these well-known engines; an illustration of one of them of the 1835–7 period may be found in Colburn's "Locomotive Engineering," page 39. Colburn's and D. K. Clark's illustrations of these engines also show the spark arrester on the chimney. The exact date of the introduction of these adjuncts to Bury's engines is not known, but they were not fitted to the majority of the engines built by the firm. The London and Birmingham Railway, of which line Bury was chief locomotive engineer, had no less than 109 of the four-wheeled passenger and goods engines, and none of them appear to have been supplied with spark arresters. The available evidence seems to point to an American source as the origin of these. They appear on many early American engines, and possibly Bury was asked to fit them to the subsequent locomotives which he exported to the States.

Of the single passenger engines: the first to be constructed was the Liver, which was put into regular service on the Liverpool and Manchester Railway in 1832, and was possibly the fourth engine built at the Clarence Foundry. The firm did not repeat the large 6ft. wheels for any four-wheeled engines, and the Liver had driving wheels of the more modest diameter of 5ft., the cylinders being 11in. by 16in. The Liver has for many years been described and illustrated as a standard Bury type engine with bar frames, but recent research into the history of the early Liverpool and Manchester engines has brought to light evidence from official record, which appears to show that Bury's Liver of 1832 had outside frames and was of Stephenson's "Planet" type. The writer is indebted to Messrs. R. Stephenson and Co., Limited, for this information.

† Fig. 1 was originally published in "The Locomotive," April, 1917.

It therefore appears probable that the first of Bury's bar framed 2–2–0 passenger engines was exported to America about 1834–5, and this may account for the spark arrester shown in D. K. Clark's illustration. This engine had 5ft. wheels and 12in. by 18in. cylinders. A very similar engine, the Lark, was constructed in 1835 and sold to the London and Southampton Railway, and was the earliest of the class built for this country as far as the writer can trace. From this time, when the engines became standardised, the driving wheels, as in the Lark, were increased to 5ft. 6in. diameter. The cylinders were 12in. by 18in. in the earlier engines, but were increased in 1839 to 13in. by 18in. In 1841 a number were built with 5ft. 9in. wheels and 13in. by 18in. cylinders, and the last four-wheeled passenger engines built for the London and Birmingham Railway in 1845 had similar large wheels with 14in. by 18in. cylinders.

Of these passenger engines about 180 were supplied to various railways in this country, and about a dozen went abroad, of which the United States had eight.

Here it may be remarked that only about 110 of the total number were built at the Clarence Foundry. Edward Bury certainly appears to have been endowed richly with the "commercial instinct," which may be defined as the art of getting people to buy things, either which they do not want, or of which they do not know enough. In his case, it took the latter form of persuading would-be buyers of locomotives that the four-wheeled engine was infinitely superior to anything that ran on six wheels, and it must be freely admitted that for many years he thoroughly believed this himself. His arguments are quoted in D. K. Clark's "Railway Machinery," page 13, and need not be repeated here. The result was that the firm booked many more orders than it could possibly execute at its own works, and the surplus were let out as sub-contracts to a large number of other firms. Of the four-wheeled passenger engines alone about seventy were built outside. The last engines of this type were built in 1845.

On the Liverpool and Manchester Railway, on which several of Bury's early engines ran trial trips, there was only one engine of Bury's build, and on the Grand Junction Railway, which until 1842 also had its locomotive headquarters at Liverpool, there were none at all. In this respect Mr. Bury was without honour in his own country, since both railways preferred six-wheeled engines.

The four-wheeled coupled goods engines were all modelled after the original Liverpool, though the later examples had a longer wheel base and larger boilers. There was also more variation in the sizes of wheels and cylinders than in the case of the passenger engines. The driving wheels varied, 4ft. 6in., 4ft. 9in., and 5ft. being the usual sizes; but there were a few of the type with 5ft. 6in. wheels, which were evidently intended for passenger traffic. The cylinders in the early engines of 1832 were 11in. by 16in., but were progressively increased to 12in., 13in., and 14in. diameter by 18in. stroke. Then the stroke was lengthened to 20in. for 14in. and 15in. cylinders, and finally about 1844–5 a standard size of 15in. by 24in. was adopted. The total heating surface increased by stages from about 300 square feet to 850 square feet, and the pressure from about 50 lb. to 120 lb. per square inch.

In all these engines the raised spherical topped copper fire-box shell and internal copper fire-box of semi-circular cross section were retained. This form of fire-box was one of the features of all Bury's engines until the end of 1847. To accommodate the circular sides the bar frames were bent round the fire-box as in Fig. 3.

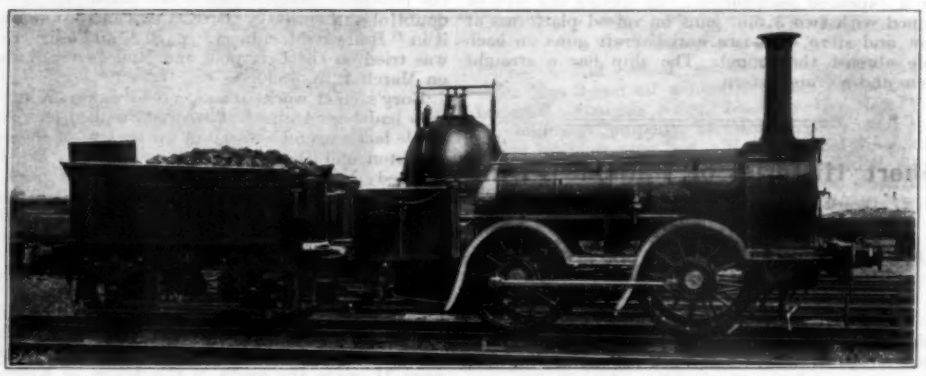

FIG. 2—ENGINE FOR THE FURNESS RAILWAY, BUILT IN 1846

Figs. 2 and 3 show the last of these engines to remain at work, the sections Fig. 3 being taken from Mr. W. F. Pettigrew's paper on "Furness Railway Locomotives," read before the Institution of Mechanical Engineers in 1901, in which a complete description and detailed dimensions were given. The two engines, Furness Nos. 3 and 4, were built by Messrs. Bury in 1846; engine No. 4 worked until January, 1898, and No. 3, which is still preserved at Barrow, was withdrawn from service in December, 1898. The record of fifty-two years' service speaks well for the workmanship and materials of Bury's engines.

One more four-wheeled engine deserves mention. This was a saddle-tank engine—Fig. 4—which was built in November, 1847, for the Shrewsbury and Chester Railway, and may be said to share with the Furness engines the honour of being equally long-lived. It was built with a saddle tank and was one of the earliest tank engines of this type to be constructed. It was also the only tank engine of Messrs. Bury's build known to the writer.

The illustration shows this engine after it had undergone some modifications in 1866 at the Wolverhampton works of the Great Western Railway. The boiler barrel was renewed and the dome in the middle added, but the old Bury copper fire-box and casing were retained. The old bar framing and motion were not altered, but more modern splashers were added. The brake gear shown formed part of the original engine, and consisted of a long horizontal screw with

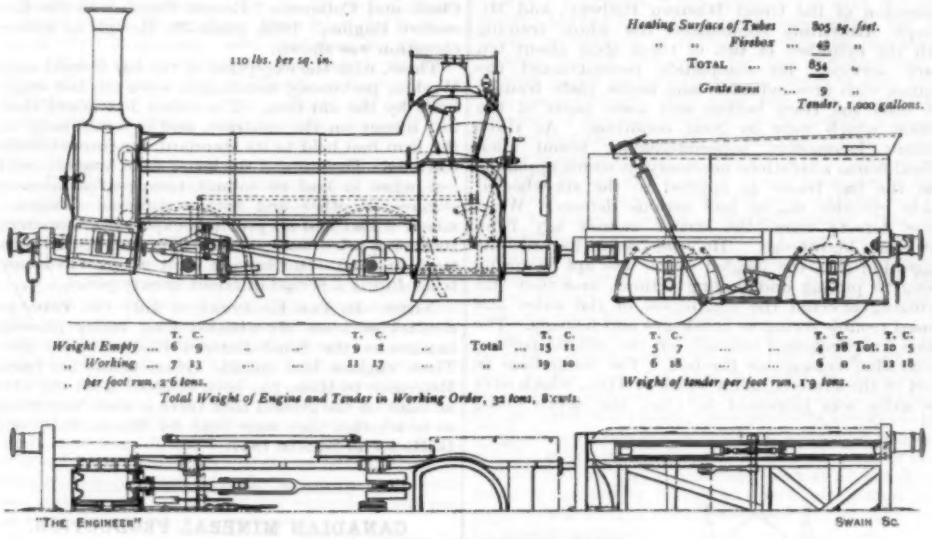
110 lbs. per sq. in.
Heating Surface of Tubes ... 805 sq. feet.
" " Firebox ... 49 "
TOTAL ... ... 854 "
Grate area ... 9 "
Tender, 1,000 gallons.
T. C. T. C. T. C. T. C. T. C.
Weight Empty ... 6 9 ... ... 9 2 ... Total ... 15 11 5 7 ... ... 4 18 Tot. 10 5
" Working ... 7 13 ... ... 11 17 ... " ... 19 10 6 18 ... ... 6 0 " 12 18
" per foot run, 2·6 tons. Weight of tender per foot run, 1·9 tons.
Total Weight of Engine and Tender in Working Order, 32 tons, 8 cwts.
"THE ENGINEER" SWAIN Sc.

FIG. 3—SECTION OF FURNESS ENGINE

right and left-handed threads, so arranged that the movement of the nuts caused the brake blocks to be forced on to each wheel from either side. The screw was supported at each end by brackets and was rotated by means of a hand wheel on the footplate. The wheels were 4ft. diameter when new, and stood on a wheel base of 7ft. 4in. The cylinders were 15in. by 24in.

In 1886, when the above engine and fire-box had run 463,660 miles, the fire-box tube plate was drilled for analysis, and it is worth noting that this early copper plate of 1847 had the comparatively large percentage of 0.26 of arsenic, the percentage of copper being 99.49. Very few plates from various much more modern engines, which were analysed at the same time, gave such a result, which is well within the present Class B specification for copper

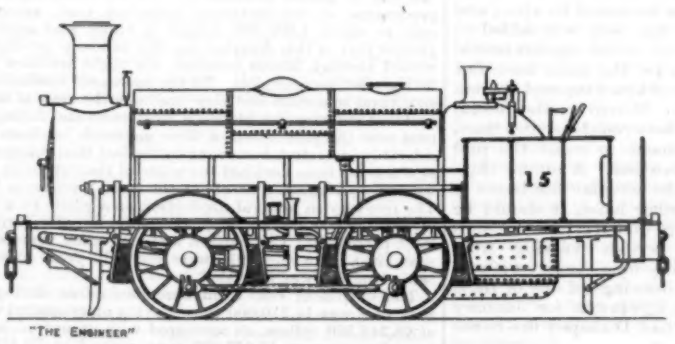

FIG. 4—SHREWSBURY AND CHESTER ENGINE, 1847

plates for locomotive fire-boxes issued by the British Engineering Standards Association.

The boiler worked at a pressure of 130 lb. per square inch. In 1887 the boiler barrel was renewed once more, but the old fire-box was again retained, as it was still in good condition, and in 1890 the bottom circular bars of the frames were replaced by new bars of rectangular section. The engine with the old fire-box was finally broken up in August, 1904, after fifty-eight years of constant work in the Wrexham and Chester districts.

Edward Bury was remarkable in that, at one period, 1837 to 1845, he combined the conflicting *rôle* of a private locomotive manufacturer with that of the chief locomotive superintendent of one of the leading railways—the London and Birmingham. Consequently all the early engine of this company were of his four-wheeled pattern. It is fair to add that many of them were built at the works of private firms other than his own. Messrs. R. and W. Hawthorn built six of them, and a considerable number were constructed by B. Hick, of Bolton, and by the well-known marine engine firm, Maudslay, Sons and Field. But, in addition, Bury was also the power behind the scenes in the locomotive department of the Midland Counties Railway, and was responsible for the designs of forty-five out of the forty-seven engines constructed for that railway. All these were four-wheeled engines, of which nineteen were built at Clarence Foundry.

Naturally, his works had considerable opportunity for standardisation of both engines and parts, a practice which was carried out to the full. But the constantly increasing demands for power caused departures from rigid standards to be fairly frequent. It is within the truth to say that of the first 350 engines built at Clarence Foundry until the summer of 1848, every engine was of the firm's own design with bar frames, and the other well-known Bury characteristics.

Towards the end of 1845 the first change in the firm's practice took place. As far as the writer can trace, all the engines hitherto built, nearly 200 in number, had had four wheels only, with the exception of the unfortunate Dreadnought and a Bolton and Leigh engine. The advantages of six-wheeled engines had gradually forced themselves upon the minds of those responsible for railway transport, and, moreover, engines of greater power were becoming increasingly necessary. Bury found that, unless he took up a less rigid attitude on this point, he was likely to lose his locomotive business. In conjunction with Kennedy he therefore prepared enlarged designs for six-wheeled engines, though adhering to the bar frames and D-shaped haystack fire-boxes. Nevertheless, the construction of four-wheeled engines was not discontinued until about three years later. As far as is known, the last four-wheeled engine, of the coupled goods type, was built in December, 1848, for the Lancashire and Yorkshire Railway.

The new express locomotives were of the 2–2–2 type, and eleven engines built in 1846 for the London and North-Western Railway had 6ft. driving wheels and 15in. by 20in. cylinders. The leading wheels retained the diameter of 4ft. 6in. of Bury's four-wheeled passenger engines, but the trailing wheels were 4ft. diameter. The boilers had tall haystack D-shaped fire-boxes and a total heating surface of 948 square feet.

Twenty similar engines were built in 1847 for the Great Southern and Western Railway of Ireland, but these had 5ft. 8in. driving wheels and 14in. by 20in. cylinders. Fig. 6 illustrates one of them, which has been preserved at Inchicore Works, Dublin, and the type of fire-box is clearly shown.

The four-wheeled goods engine was lengthened and small trailing wheels were placed behind the fire-box. Two were built in 1846 for the London and North-Western Railway with 5ft. leading and driving wheels coupled and 15in. by 20in. cylinders, but were almost immediately superseded by a similar class with 24in. stroke, several of which were put to work on the Irish railway mentioned above. They also had the large D-shaped fire-boxes. A type with six-coupled wheels 5ft. diameter and 16in. by 24in. cylinders was also designed, but only five appear to have been built, one for the Bristol and Birmingham Railway, which subsequently came into the possession of the Midland Railway, and four for the London and North-Western Railway. All were dated 1846 and

FIG. 6—GREAT SOUTHERN ENGINE, 1847

seem to have been the only six wheels coupled engines built by the firm. The wheel base was 14ft. 10in. The boilers contained 157 2¼in. tubes, the heating surface of which was 1047 square feet, to which the fire-box heating surface added 76¼ square feet, making a total of 1123½ square feet. The weight in working order was 23 tons 12¼ cwt. They had all the characteristics of Bury's designs, which included connecting and coupling rods of circular section.

At about this period the constitution of the firm, which had hitherto been known as Edward Bury and Co., was altered and the new title became Bury, Curtis and Kennedy.

Another change took place in 1848 in the designs, which probably caused Mr. Bury a pang. The D-shaped fire-box, which limited the heating surface, had to be discarded for the rectangular type, with the ordinary form of outer casing raised slightly above the boiler barrel. No dome was provided, and the steam was collected by means of an internal iron pipe which had a slit $^{3}/_{16}$in. wide along the top. The regulator rod passed through the centre of this pipe to a regulator valve placed in the smoke-box. The bar frames and coupling rods of circular section were retained, but the connecting-rods were of rectangular section in the later engines. The wheels of nearly all Bury's engines were of wrought iron with cast iron bosses, the latter being frequently covered externally with brass plates. A few of the four-wheeled goods engines of the 1845–6 period had wheels of cast iron throughout, the spokes being of channel section.

Six larger express engines of the 2–2–2 type with 6ft. 6in. driving wheels and 16in. by 20in. cylinders were built in 1848 for the London and North-Western Railway. They had leading wheels 4ft. 9in. diameter, but the trailing wheels were 3ft. 7in. diameter only. The total heating surface was 1367 square feet, of which the fire-box gave 92¼ square feet. The grate

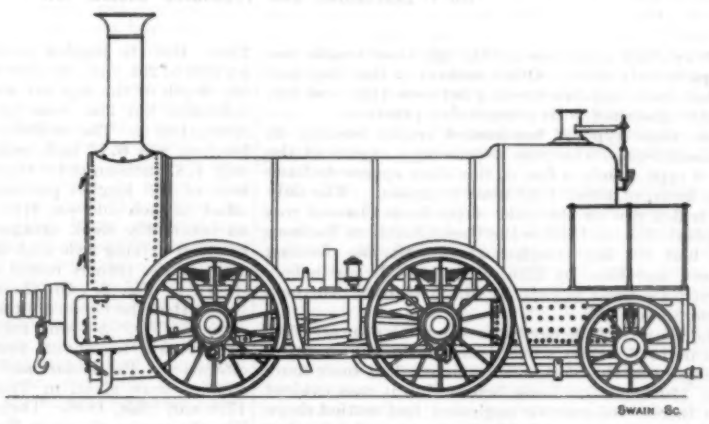

FIG. 5—FOUR-COUPLED GOODS ENGINE, 1848

area was 18.1 square feet, and to obtain such large inside fire-boxes 3ft. 7in. wide the firm found that it had to retain the method of bending the bar frames outwards. The weight of these engines was only 23 tons 6 cwt. In appearance they were somewhat similar to the Wrekin, which was built at the end of 1849 for the Shrewsbury and Birmingham Railway, but this was a smaller engine with 5ft. 6in. driving wheels and 15in. by 20in. cylinders.

The Wrekin was one of the last engines to be built by the firm, and as far as records can be traced, it was actually the last of Bury's bar-framed engines. Complete sectional views and a description of it were given in Tredgold's "Steam Engine."

Bury's large four-coupled goods engines of 1848 are shown in Fig. 5. About thirty were built for the London and North-Western, Shrewsbury and Chester, Great Southern and Western of Ireland, and the Glasgow, Dumfries and Carlisle (later the Glasgow and South-Western) Railways. The last-mentioned railway had thirteen of the class, which worked the through goods traffic when the line was opened and for some years afterwards. One of these Glasgow and South-Western Railway engines, No. 46, was selected for D. K. Clark's experiments on boiler evaporation and blast pipe efficiency, and many particulars will be found on pages 130, 131 and 156 of that author's "Railway Machinery" of 1855. Bury's standard engines of this class had 5ft. coupled wheels and 16in. by 24in. cylinders. The boilers contained 157 2¼in. tubes, and had a total heating surface of 1144 square feet, of which the fire-box provided 87 square feet. The weight in working order was about 22¾ tons, but the small trailing wheels were very lightly loaded with only about 3¾ tons.

It may be noted in connection with Bury's boilers that he always used brass tubes of very large diameter. In most of the engines built by the firm the tubes were 2¼in. diameter outside, but many of the four-wheeled engines, such as those of the Furness

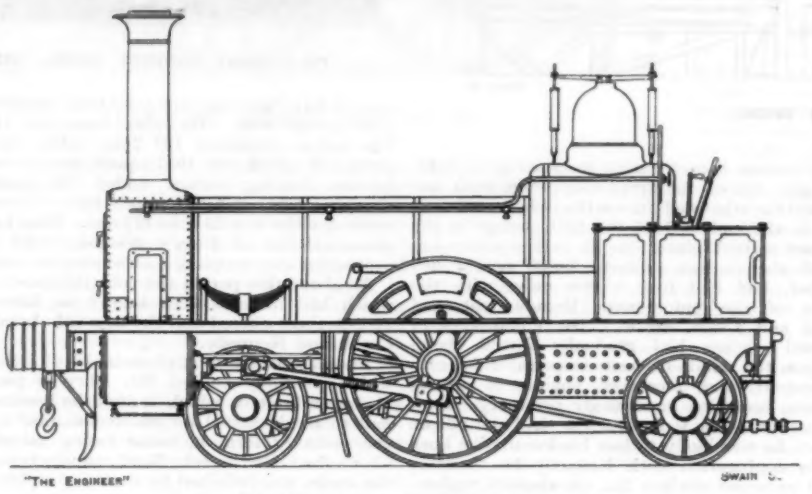

FIG. 7—LANCASHIRE AND YORKSHIRE ENGINE, 1849

Railway, had 2¼in. tubes, although their length was comparatively short. Other makers of that day had settled down to tubes varying between 1¾in. and 2in. outside diameter as in present-day practice.

One more type of bar-framed engine remains to be mentioned. This was a passenger engine of the 2–4–0 type. Only a few of this class appear to have been built, of which four went to Ireland. The only one which ran on this side of the Irish Channel was supplied early in 1849 to the Great Northern Railway and had 5ft. 9in. coupled wheels, 4ft. 3in. leading wheels, and 15in. by 22in. cylinders. It was subsequently modified in 1856 by Mr. Archibald Sturrock, as mentioned below.

But the day of the bar-framed engine was practically over in 1848. Bury's firm had had an almost entire monopoly of this design, of which it had built more than 350 engines. Long before this it was evident that British locomotive engineers had settled down to the plate frame, probably because a wider fire-box could be got in. Apparently, however, there were contributory reasons. So long as four-wheeled engines could be used, in which the trailing axle was placed in front of the fire-box, the bar frame fulfilled all requirements, and many of Bury's goods engines of this type had a surprising longevity. But when the bar frame had to be incorporated into the design of six-wheeled engines with the trailing axle behind the fire-box difficulties arose. The British locomotive superintendents did not like the very narrow fire-box which was necessitated by the width of the frame bars, and in this respect differed from their American *confrères*, who used the narrow box for many years. Bury therefore had to make his frames with a double "joggle" to meet these requirements. It is a noteworthy commentary that all Bury's six-wheeled bar-framed engines had a very short lease of life, and on the English railways with the 4ft. 8½in. gauge nearly all the six-wheeled passenger engines underwent radical structural alterations.

In the six-wheeled engines the driving and trailing horns were welded solid with the main horizontal bars, but the leading horns of the passenger engines were bolted on. On the London and North-Western Railway the six single-driver express engines with 6ft. 6in. wheels were altered by Mr. McConnell, after a few years' service, by the addition of an outside frame, a form of design which that engineer very rarely adopted for his own engines. The Great Northern 2–4–0 engine broke a crank axle, and, considering the type of framing weak, Mr. Sturrock also converted this engine to the double-framed type by the addition of an outside frame. How much of the original bar frame structure remained after McConnell's and Sturrock's alterations is uncertain, but it seems that the portions in front of the fire-box were used for the inside framing. The four 2–2–2 engines on the Shrewsbury and Chester Railway, which were of a smaller type than, but similar to, the London and North-Western engines, came into the possession of the Great Western Railway, and Mr. Joseph Armstrong condemned the whole framing with the cylinders of two of them after about ten years' service. He completely reconstructed the engines with new cylinders and inside plate frames, but used the Bury boilers and some parts of the motion which were in good condition. As three eminent locomotive superintendents found such radical frame alterations necessary, it seems apparent that the bar frame as applied to the six-wheeled inside cylinder engine had serious defects. What those defects were, the writer cannot say from historical knowledge. He can only hazard the suggestion that the joggled frame was apt to spring owing to pulling and buffing actions, and that this springing affected the squareness of the axles and caused trouble owing to breakages and heating. The frame was weakened laterally on the joggled portion round the rectangular fire-box. The main bars in front of the fire-box had a width of 4¼in., which over the axles was increased to 4¾in., the depth being 2¼in. But the joggled portion was thinned down to a width of 2in. only, in order to clear the tires, although the depth of the top bar was increased to 4¼in., and a bottom bar 2in. wide by 3in. deep was added to strengthen it. The modulus of section against lateral bending was 6.77 inch-units for the main bars, but only 4.83 inch-units for the combined top and bottom bars of the joggled portion. Moreover, the lateral offset on each side was 3¾in. between the centre lines, an inherently weak arrangement to resist the pull between driving axle and draw-bar. A similar thinning of the frames round the circular fire-boxes is shown in Fig. 3. On the other hand, it should be stated that the Great Southern and Western (Ireland) engines—Fig. 5—ran for periods varying from twenty-two to about twenty-nine years without alteration. Particulars and drawings of one of these engines were given in THE ENGINEER for January 17th and 24th, 1896. They had D-shaped fire-boxes like the engine shown in Fig. 3.

None of the 0–4–2 goods engines appear to have undergone similar alterations, but they also did not have a long life. Those on the Glasgow and South-Western Railway were completely condemned by Mr. Patrick Stirling in 1862–1866, although they were built only in 1848. Those on the London and North-Western and the Shrewsbury and Chester Railways disappeared at about the same period.

The complete ascendancy which the plate frame had attained obliged the firm again to reconsider its policy, and in 1848 it entered the field of competition with other locomotive building firms in the construction of locomotives to other engineers' designs. One of its earliest efforts in this direction was the building of the celebrated eight-wheeled single engine Liverpool to T. R. Crampton's designs. It is unnecessary to describe this engine, then considered to be the ultimatum of the "narrow" gauge. Suffice it to say that it had 8ft. rear driving wheels, 18in. by 24in. cylinders, 2290 square feet of heating surface, 21½ square feet grate area, 120 lb. pressure, and weighed 35 tons. It was sold to the London and North-Western Railway and was shown in the 1851 Exhibition. But it proved much too heavy for the light rails of that period, and was broken up by Mr. McConnell in 1858, after an existence of only ten years.

Messrs. Bury, Curtis and Kennedy then obtained a large order for thirty passenger engines to Mr. (afterwards Sir) John Hawkshaw's designs† for the Lancashire and Yorkshire Railway—Fig. 7—the first of which was delivered in January and the last in August, 1849. These had inside plate frames and outside cylinders, 15in. by 20in. The diameter of the driving wheels was 5ft. 10in., and that of the carrying wheels 3ft. 6in. The connecting-rods were deeply forked. The engines had fire-box casings raised 1ft. above the top of the boiler barrel, and the copper-cased dome above the fire-box contained a double-beat regulator. Sections of these engines were illustrated in D. K. Clark and Colburn's "Recent Practice in the Locomotive Engine," 1860, plate 32, though no external elevation was shown.

These, with the exception of the bar-framed engine Wrekin, previously mentioned, were the last engines built by the old firm. The writer has heard that it lost money on the contract, and it would seem that the firm had held to its standard bar-framed designs too long. The costs of the latter were known exactly, but when it had to submit competitive prices for engines to other and totally different designs, of which it had had no previous experience, apparently too low a price was quoted. The firm ceased operations in 1850, after having built about 415 locomotives during a period of about twenty years.

NOTE.—In THE ENGINEER of July 1st, 1910, particulars of some six-wheeled long boiler passenger engines for the South-Eastern Railway were given. These engines had outside cylinders and bar frames. Reference to them has been omitted from the above account on the ground that there is some uncertainty as to whether they were built by Messrs. Bury or by B. Hick and Sons in 1847.

CANADIAN MINERAL PRODUCTION.

THE Dominion Bureau of Statistics has announced that its preliminary estimate of the mineral production of Canada during 1922 shows that the total value amounted to 180,622,000 dollars, an increase of practically 6,000,000 dollars over the production of the previous year. The value of the metals produced was 61,731,000 dollars, as compared with 49,343,232 dollars in the preceding year; fuels and other non-metallics dropped 4,000,000 dollars to a total of 83,891,000 dollars, and the production of structural materials and clay products has been estimated at the same valuation as last year, namely, 35,000,000 dollars.

In metals the outstanding feature was the production of gold, which for the first time since 1902 was above the million-ounce mark, and was 31 per cent. above the production of the preceding year, reaching a total of 1,200,000 oz. Silver was 2,000,000 oz. higher than in the preceding year, and the total production of 15,726,000 oz. was valued at 10,634,000 dollars.

The lead output increased 50 per cent. to a total of 98,738,000 lb., with an estimated value of 6,141,000 dollars. Copper rose about 3,500,000 lb. to a total of 51,229,000 lb., valued at 6,833,000 dollars. The increase in the production of metals during the past year, amounting to approximately 12,000,000 dollars in value, marks a resumption of progress in the metal mining field, and points the way to greater prosperity. The slight decline in the production of non-metallics, including coal, amounted only to about 4,000,000 dollars in value, and since the greater part of this decrease was due to loss of production caused through labour troubles, the slight set-back may be regarded as negligible. In the successful marketing of structural materials and clay products the revival of the building industry has played a great part, and during the past year the production of these materials has been considerably increased, but owing to the fact that prices have at the same time declined the value of the output in 1922 was only maintained at about the same level as in 1921. The recovery in mineral production as a whole to a total of 180,349,000 dollars may therefore be considered as most propitious. Comparison with preceding years shows that 1920, 1918 and 1917 were the only years in which this valuation was exceeded.

The output of coal from Canadian mines during the past year was 14,210,000 tons, having an estimated value of 68,349,500 dollars, as compared with an output in the preceding year of 15,057,493 tons, valued at 72,451,656 dollars. The output of asbestos in 1922 reached a total of approximately 139,000 tons of all grades, valued at 5,200,000 dollars, as compared with 92,761 tons, valued at 4,906,230 dollars in 1921. The increased production was due almost entirely to the activity at the mines during the last few months of the year.

MUCH of the placer gold that comes from the Yukon Territory is mined by means of dredgers, some of which are among the largest in the world, capable of excavating and treating 15,000 cubic yards of gravel per day. These dredgers are operated by electric power, and have been found to be most satisfactory. The period of operations is not confined to the short summer season prevalent in that district, as they can operate long after winter has set in. On one occasion a dredger operating on the Klondyke River was maintained in service all the winter. There are six dredgers used for this purpose in the Yukon Territory.

† The actual designer was Mr. Hurst under Hawkshaw's supervision.

The Public Supply of Electricity.

A JOINT meeting of the Midland Branch of the Institution of Mechanical Engineers, of the Birmingham and District Association of the Institution of Civil Engineers, and of the South Midland Centre of the Institution of Electrical Engineers was held, by the kind permission of the Lord Mayor, in the Council Chamber, Birmingham, on January 25th, 1923, to discuss "The Advisability of Limiting to Super Power Stations the Public Supply of Electricity." The chair was taken by Mr. Loughnan St. L. Pendred, Member of Council of the Institution of Mechanical Engineers and Editor of THE ENGINEER, supported by Major S. J. Thompson, D.S.O., the chairman of the committee of the local branch of the Institution of Mechanical Engineers; Mr. J. E. Swindlehurst, president of the Birmingham Branch of the Institution of Civil Engineers; and Professor W. Cramp, D.Sc., M.I.E.E., president of the South Midland Centre of the Institution of Electrical Engineers, of the University of Birmingham. About 320 members of the three societies and visitors attended the meeting.

The debate was opened by Sir Vincent L. Raven, representing the Institution of Mechanical Engineers, who said he felt certain that unless electricity could be produced at a cheaper average rate than it was to-day many prospective users would be prevented from using it. It was interesting to observe that during a certain electricity inquiry, which took place in London about the middle of 1922, statements were made by several of the large power companies which indicated their willingness to enter into an agreement to supply power at a rate approximating ½d. per unit; but that offer was qualified by dependence upon fluctuations in coal and other prices, and it might be regarded as a general indication of what could be done at that time in the direction of producing cheap power. Hence, said Sir Vincent, he felt sufficiently confident of the future to make a definite statement that power supply at a price not exceeding ½d. per unit could be regarded as imminent.

The idea of super power stations, if the idea meant a limited number of super power stations erected in the country at suitable places distributing through main trunk lines, was admittedly impossible owing to the enormous capital outlay. It must, however, be equally realised that a number of small units placed in positions where water towers would have to be used and where no consideration had been given to cheap delivery of the necessary fuel, was as expensive and a great prohibitive to cheap power supply. Large power stations with from at least 15,000 to 20,000-kilowatt turbo-alternators should be erected, and they should be placed in carefully selected positions adjacent to a good water supply within easy reach of good and cheap transport of the fuel required. One of the objects essential to cheap supply outside capital cost was that the plant should be so arranged as to produce electricity with not more than 2 lb. of coal per unit, which, Sir Vincent was confident, could be done.

Continuing, Sir Vincent Raven said that in the process of evolving the common system, linking up the existing generating stations might be helpful as a first stage, but it should not be dissociated from a well-considered policy of modern plant extension, preferably in a new station or stations. In some of the districts such stations—which, for want of a better name, might be called capital stations—were already in commission, for instance, the North-East Coast, Birmingham, Glasgow, and Edinburgh, and others were under construction or about to be commenced—Manchester, Barking, Stourport, Salford, Preston, Nottingham, Ferrybridge, Liverpool, Rugeley. These stations embodied a radical departure from the old cycle which had held the field since 1900, *i.e.*, 200 lb. steam pressure, 550 deg. Fah. steam temperature, and 28 in. vacuum. The new conditions were 300 lb. pressure, 700 deg. Fah. temperature, and 29.1in. vacuum, which, in combination with the interheating of the steam and other refinements associated with large plant units, made a heat consumption of 17,000 B.Th.Us. per unit a practical figure under good working conditions. In specially favourable situations the figure of 14,000 B.Th.Us. per unit was possible. The cost per kilowatt of plant installed was low owing to it being possible to use boilers and turbo-alternators of the maximum size. Incidentally, it might be remarked that the sites of these stations are seldom less than 25 acres, and in some cases considerably greater, so that full advantage could be taken of any new method of dealing with the coal before the heat was utilised in the boilers.

It was surely obvious that capital stations were required in increasing number; to make the best use of them they must be run on a high load factor and the larger of the older stations left to take the peaks of the load. Bulk supplies should be made available to the smaller and ill-placed stations in a district at the earliest opportunity. It was a waste of money to extend those stations even although it could be shown by estimates that for a time at least the extension would bring about such an improvement as to give a better result than by taking a bulk supply.

In conclusion, Sir Vincent said it could not be too strongly contended that the policy of anticipation of needs was essential to the full development of electricity supply. If proper facilities were provided as the result of the most efficient generation of electricity, the expansion in the business of public supply would be enormous, bringing in its train improved load and diversity factors. An examination of the figures of consumption per head of population clearly demonstrated that the go-ahead people reaped the reward. He thought he had said enough to show that in his opinion, while there was no case for the complete transference of existing loads to capital stations, those stations were the main factor in the common system from which all users would draw their supply if a thoroughly progressive policy was encouraged and followed in the electricity supply business.

Mr. Alfred Dickinson, representing the Institution of Civil Engineers, then spoke. He said it could hardly be expected that those responsible for the design or working of ordinary power stations would become ardent advocates for the development of modern super power stations to compete with their own undertakings. His view was that in the best interests of super power stations the users of electrical energy and the electrical industry as a whole, super power stations should be permitted to supply energy not only in any district, but to any consumer willing to take it. The main reason for such stations was the hope to supply electrical energy cheaper than was possible from existing stations. If that was a correct assumption, would not limitations and restrictions precluding certain consumers from purchasing that power thwart the object for which the super power stations were being established?

He believed that in the near future coal would not be used for steam generation in the way it had been used in the past, but that it would be distilled or treated in some way to get therefrom many products for sale, and in obtaining those products low-grade gas would be produced as a by-product, and would be available for steam generation or utilisation for power production in some way. Assuming such an undertaking, could it not supply energy at a cost below that of a super power station installed for and producing power by present methods? Suppose an undertaking of the character indicated was established, should it not be permitted to dispose of cheap power in competition with super or any other existing power station?

In November, 1918, during a discussion at the Institution of Civil Engineers, among other things, he said that if the legislators of this country amended the law so as to permit of the distribution and sale of power without regard to county or municipal boundaries, cheap power could be supplied throughout the country, and his view was that in the near future electrical energy would be manufactured more as a by-product than a main product; further, that under favourable conditions there was no reason why the price of electrical energy should not be brought down to such a rate as to make it available for practically every domestic use, including cooking and heating.

Mr. R. A. Chattock, representing the Institution of Electrical Engineers, said the suggestion contained in the subject of the discussion, viz., that the public supply of electricity should be limited to super power stations, was one that he could not endorse unreservedly. Such stations would cost huge sums of money, and the millions of pounds already spent upon the existing stations, which it was assumed would be scrapped, would create a heavy financial burden that would have to be met out of the revenue obtained from the sale of electricity, and that would far outweigh any benefit that might be derived from the cheaper operation of the new plant. It was apparent that development must go on upon sound financial and engineering lines that had governed the development of the existing large undertakings throughout the country, and which had proved themselves capable of meeting the requirements of their districts and of cheapening the cost to the consumer at the same time. Such methods aimed at utilising the older generating stations to meet the intermittent or peak load demand, which was only felt for a few hours a day, and at carrying the bulk of the supply throughout each twenty-four hours on the more modern stations in which the highest economy could be obtained.

In order to justify his conclusions Mr. Chattock presented some figures giving the average results obtained in existing generating stations of various descriptions. They are compiled from that well-known book, "Garcke's Manual," and deal with the figures covering the year ending March 31st, 1921. He had taken three typical undertakings in each group and averaged the results obtained in them. The groups comprised:—

(1) Three undertakings in this country operating modern steam-driven stations of high economy as well as older and less economical stations, and in which development has proceeded on the lines he had described. The average capacity of these stations is 114,000 kilowatts.

(2) Three undertakings operating steam-driven stations, the average capacity of which is 50,000 kilowatts.

(3) Three undertakings operating steam-driven stations, the average capacity of which is 20,000 kilowatts.

(4) Three undertakings operating steam-driven stations, the average capacity of which is 5000 kilowatts.

(5) Three smaller undertakings operating steam-driven plant, the average capacity of which is 1000 kilowatts.

(6) Three smaller undertakings operating gas engine-driven plant, the average capacity of which is 575 kilowatts.

(7) Three smaller undertakings operating oil engine-driven plant, the average capacity of which is 520 kilowatts.

(8) The Nechells super power station of the Birmingham Corporation, equipped with the most modern turbine plant, the ultimate capacity of which will be 105,000 kilowatts.

A.	B.	C.	D.	E.
Group.	Average capacity of plant installed K.W.	Works cost per unit generated.	Station cost per unit generated, including capital charges.	Total cost per unit sold, including capital charges, rates, taxes, management, transmission and distribution.
		d.	d.	d.
(1)	114,000	0.87	1.27	1.95
(2)	51,000	0.88	1.39	2.32
(3)	20,510	1.27	1.81	2.70
(4)	5,375	1.80	2.58	3.87
(5)	1,000	2.14	3.02	—
(6)	575	2.73	3.82	—
(7)	520	2.04	3.12	—
(8)	105,000	0.208	0.44	—

The figures given showed that the larger the undertaking the cheaper could electricity be produced, and that when the cost of transmission and distribution was included the large undertaking could still easily beat the small station. That, of course, was partly due to the greater diversity factor of the supply given by a large undertaking, and to the preponderance of the day or power load, which had such a marked effect on the cost of production.

Lieut.-Col. E. Kitson Clark said that from the examinations he had made of stations, he had come to the conclusion that at present the large generating station was best considered in terms of 50,000 kilowatts, and as far as he could read and learn, the super station was made up by a repetition of such units. Those who knew the difficulties would, he hoped, correct him afterwards; but he should say, from what he had been told, that up to the present time, for reasons connected both with the complication of switches, with the boiler power, with the method of getting in and storing coal, and with the supply of water, and the supply of air to the boiler-house, the best unit was round about 50,000 kilowatts. He was further told that, speaking approximately and considering only large-size generating works, having boilers opposite each other, with overhead economisers, &c., that 5 kilowatts of generating plant and 3 kilowatts of steam-raising plant could be accommodated per square foot of ground. That proportion was very significant. It appeared to him that they had got to wait until they found that their boiler-room was not so much in excess of the room required for the generator. As at present circumstanced they would have to have coal mines of enormous size if they were going to supply the coal which they could economically use in producing steam for generating electricity. It would be very difficult to find a single mine that could do that, and therefore they would have to transport coal. And if they came to transport coal on a well-found railway like the North-Eastern, the actual distance, he should say, would not so much matter. He submitted, therefore, that one of the reasons for locating their generating power at or near the pit head fell to the ground at once, until they were provided with a far better system of getting their steam power

Mr. J. H. T. Legge observed that there was no doubt they must have cheaper current for industrial purposes. For lighting he was not so sure. He thought, generally speaking, people got very good value in electricity for lighting purposes, the unit doing so much, and ever more efficient lamps coming into use. At the present time, as he saw it, they were really just about to take the proper view of the problem of generating electricity. They had proceeded for many years past in a parochial way, and now, under the auspices of the Commissioners, people were beginning really to take courage, and particularly his municipal friends, in thinking possibly there might be something in generating electricity on a big scale and outside their areas. The generating cost in small stations during the few hours of the day, when the industrial load was added, say, for fifty or sixty hours per week, undoubtedly was very good—even with small plants they could show some good figures—but for the remaining hours of the working week their costs rose enormously. He had had occasion in taking over a station recently to go into those figures, and it really was astonishing the cost per unit in generating during those hours when they might say the industrial load was not there. It amounted to three and sometimes four times the average cost. With a much bigger area of supply for the large station there would be advantages arising from having a better and bigger "diversity" factor. A big power station would, of course, be placed at the point most suitable for cheap generation, namely, alongside ample water supply, and in the neighbourhood of collieries. The old idea, which was referred to in the public Press some time ago, was to put the big stations at the pit head. That bubble was burst long ago, for the reasons

stated by Colonel Kitson Clark, that they could not find collieries capable of supplying the requisite fuel.

Sir Henry Fowler said they were all satisfied, he thought, that it was more economical to produce current in stations of the largest size, and common sense pointed out where they should be placed. The question of finance rather than that of engineering, then, had to be considered: the question whether they should generate in a huge power station or in a small station such as one he had seen that day. There the steam which was used for all ordinary purposes drove the set, lighted the works, and provided the necessary power for the drill; in addition, light was supplied to the coaches. He was strongly of opinion it would not pay to change that system for a supply from a super station. It was wholly a question of economics and individual circumstances.

Mr. S. T. Allen expressed the view that the meeting had got off the subject as expressed in the question for discussion. Neither an affirmative nor a negative reply could be given. He thought the evidence of those who had been going into this matter for years showed that the answer might be divided into two parts. If the proposal were that the super stations should apply to the whole country, the answer would be "No." It was necessary to consider our national resources, including water power, to say nothing of waste heat. The data at present available would not permit of a definite reply. Again, if the country were divided into districts, the answer might be either "Yes" or "No." So much depended upon the circumstances of the case, and they were many and varied. The size of a district must be considered, as well as the density of the load in the whole district or in the various sections of a district. The question of the load factor was most important, and unless figures were given of the load factors, the statistical statement put forward by Mr. Chattock was deprived of much of its value. Again, the conditions as to fuel, water and transport came in. If they took two areas the conditions might be entirely different; a super-power station might be the most suitable for one district, and a group of small stations for another; and yet each scheme might in itself be absolutely sound.

Major A. M. Taylor spoke on the cost of transmitting power by underground cables, as against that of carriage of the coal to the generating station. In selecting the most suitable site for the generating station we had to consider both water *and* coal, and sometimes water was the more important. The cartage of coal, assuming the use of 2.75 lb. per k.w.-hour, was taken as the basis, and railway carriage at 1.2d. per ton-mile, which worked out at .044d. per kilowatt-hour generated per 30 miles of carriage. In a paper which he had recently read before the Institution of Electrical Engineers it was shown that, by using 100,000 volts, 50,000 kilowatts could be transmitted over 30 miles at an initial outlay, on account of cables only, of £0.266 per kilowatt per mile. By stiffening the copper 100,000 kilowatts could be transmitted over the same six cables at a cost of £0.17 per kilowatt per mile. He understood that at least one firm of cable makers was prepared to make these cables to work under a maximum potential gradient of 50,000 volts per centimetre, which would permit the voltage of transmission being raised to 150,000 volts. That would enable 200,000 kilowatts of power to be transmitted over the same six cables. The increased power would bring down the capital outlay to £0.085 per kilowatt per mile, and interest and sinking fund at 10 per cent. worked out, *for the whole* 30 *miles*, under those conditions, to only .018d. per kilowatt-hour. That was the figure which would have to be added to Mr. Chattock's 0.44d. on account of capital outlay alone. To that, however, must be added the cost of the loss of energy in the line and in the step-up and step-down transformers.

Professor Cramp said let them suppose there was a super station in a district, as well as a colliery or group of collieries, with a certain amount of slack, not worth more than 5s. or 6s. per ton as it lay. Was it possible for the super station to supply energy to those collieries at the same price they could generate it for themselves? If they could, all well and good; let them do it. But if they could not, there should be no monopoly; it should not be possible for those immediately concerned with super stations to say in such circumstances: "You shall have the power from us; you shall not generate it for yourselves." If the proposal were to limit the public supply of electricity to super stations, then his answer was, "Certainly not." It was a matter of finance; but, apart from that, it was a question of whether it would pay, not from the point of view of capital cost, the consumer to take power from the super station or not. If not, he should not be compelled to take it. He agreed that it would be well to get rid of many small and uneconomical stations, and that districts should be supplied from super stations erected in suitable places. But to avoid the difficulties he had mentioned there was only one solution: there must be complete freedom in such cases and no tyrannous monopoly.

Mr. J. C. Vawdrey said his belief was that super power stations would find and take their natural position. The super power station which Mr. Chattock was developing in Birmingham was on a pretty big scale, and he was rather doubtful whether they would see in that country stations of very much bigger dimensions. They found that manufacturing concerns reached a certain point beyond which it became uneconomical to extend, and his impression was that the power station would be limited by the district which it had to serve and by certain economical units.

Mr. Selby, referring to Sir Henry Fowler's suggestion that they ought to have had accountants taking part in the discussions, said the accountants' part of the matter was what the electrical engineer was now fighting against, as also against legal opposition. The attitude of the accountant was always what might be called the immediate prospectus; for any financial man to examine a proposition meant that he would always cut out any hopes of the future, however good they might be, in favour of an immediate financial return on his outlay, and that, perforce, was the line the electrical engineer must work upon, unless some form of Government monopoly came about; but there was no monopoly, and there never could be. There might be legislative enactments, giving certain powers, and imposing certain duties. It was an open question whether the powers which had been given had at all compensated for the onerous duties laid upon certain undertakings.

Professor Lea said if he understood the history of the development of electrical engineering, it had been a development from the small unit to the large unit, by mistake and success; a development also of large power units from the prime mover side. He thought it had been admitted that they would not, in the super power station, develop power at much less than, or at a greater economy than, 2 lb. of coal per kilowatt per unit. Some had suggested that it ought to be 2¼ lb. of coal, because coal of an inferior quality was used. He thought there might be possibilities of producing power in the future with a consumption of coal of perhaps 1 lb. or even less per unit. That might be possible, though he did not know. If it was possible, then, first they would start with a small unit, and, by mistake or success, they would eventually arrive at a large unit. If they concentrated too much on the large super station they might run a risk of escaping the possibility of development, which would only take place probably in smaller stations, and proceeding from the small unit to the large unit. He believed that any limitation of public supply to super-power stations would imperil future developments in the electrical industry.

The Chairman, in closing an interesting discussion, said he thought, on the whole, if he asked for a vote upon the point, they would all agree that there must be "no monopoly." Sir Henry Fowler had told them it was an economic question, and not a question for engineers at all, but he held it was their first business to be good engineers. They had got to think about reducing the coal consumption and increasing the efficiency of their plant. Afterwards, as a secondary matter, the question of economics had got to come in. The highest economy was not always of necessity the best policy. They were all, he thought, perfectly agreed that they could generate electricity more cheaply in a super power station than in a station of smaller capacity. It did not follow that the super power station was the best station for generating electricity. There might be other reasons, altogether apart from the mere economy of generation, which would have to be considered. He had learnt from the Electricity Commissioners that, although they anticipated no considerable improvement in the efficiency of the best stations, they did believe—and it was a very important point—that there would be a considerable increase of efficiency in the medium stations.

Mr. A. C. Pain wrote to say: Are we going on indefinitely throwing away 61 per cent. of the heat of the coal with the cooling water? It seems too absurd to burn these huge quantities of coal and then to erect enormous cooling towers to dissipate uselessly such a large proportion of the heat units generated. Surely some better system must be found eventually, and in the meantime the most likely way to perpetuate or prolong such a system is to give a monopoly to the super power stations. Such stations, if they are to supply small quantities of electricity, should also be required to receive small quantities of electricity from anyone who can generate more cheaply, and that would be a great incentive to a solution of the problem and the better utilisation of our precious coal supplies than the super power stations afford.

THE hon. general secretary of the Institution of Locomotive Engineers (London) is Mr. J. C. Sykes, whose office is Denison House, 296, Vauxhall Bridge-road, S.W. 1. Mr. G. F. Burtt will continue to act as treasurer.

THE engineers who investigated the possibilities of electrification of the Temiskaming and Northern Ontario Railway, which is the property of the Provincial Government and serves the silver and gold mining districts of Cobalt and the Porcupine, have reported in favour of the undertaking. They recommend the electrification of the main line from North Bay to Cochrane (252.3 miles), of the Iroquois Falls sub-division (7 miles), and the Porcupine sub-division (33.1 miles) as providing a sound and self-supporting investment for the capital funds of the Province in a further development of Northern Ontario. The estimated cost of the project is 11,215,000 dollars. The commission operating the system for the Government, however, will have further investigation made before starting work on the scheme. As a first step the Government will acquire a title to the undeveloped water power of several rivers along the route of the railway.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

ELECTRIC WELDING.

SIR,—I have read with considerable interest Mr. Caldwell's article on electric arc welding apparatus and equipment, and would like to draw attention to Mr. Caldwell's statement in regard to the polarity of the electrode, since my experience tells me that it is not the established practice, as he asserts, to make the work positive and the electrode negative, and previously in his paper he asserts that deposition takes place equally well whether the electrode or the work is positive.

There appears to be little doubt that a lagged or flux-covered electrode presents no insuperable difficulty, and excellent results can be obtained with either the electrode negative or positive.

The difficulty experienced by many welding engineers in the use of bare electrodes is largely attributable to the fact that most welding machines are incapable of delivering a steady arc so necessary to satisfactory results with bare rod, and since the general practice is to use a positive electrode with the work negative the fusion of the two metals has not been all that could be desired.

I think Mr. Caldwell's statement that a flux-covered electrode is necessary should have been qualified considerably. I am able to state that bare steel electrodes, not only mild steel but high carbon and manganese steel bare electrodes, are being used in considerable quantities with very highly satisfactory results where the proper welding conditions to overcome difficulties have been provided, and since the proof of the pudding is in the eating thereof, I take it that Mr. Caldwell has not obtained tests of welds with all kinds of electrodes used in conjunction with every description of welding plant.

It is possible to refer your readers to a number of engineers who have during the past three years used bare electrodes in carrying out all classes of shop and general repair; but I will conclude by quoting an extract from a letter from a user of bare electrodes which I think speaks for itself: "At the commencement of our experience, many useful lessons were learned, as we soon found out that we could not secure good electric arc welding with inferior workmanship, brought about by our welders not being able to steadily maintain a proper arc length by manual control of the arc, only for short periods, and it took time and patience to arrive at that degree of skill so necessary for successful welding, which means if the proper arc length is maintained uniform the drop across the arc will never greatly exceed 25 volts for bare electrodes. Our experience shows that not only can we weld truck frames, motor cases, gear-cases, wrought iron, steel, cast steel, malleable or grey iron, cast iron, &c., with bare metal electrodes, but these few examples merely suggest the range of uses our welding operations have extended to, and that so far thoroughly sound welds have been made with all these metals."

A. E. SHORTER, M.B.E., A.M.I.M.E.

CHINA.

SIR,—It is exhilarating to read the reports of your Commissioners in China; their information is the most accurate that has ever been publicly expressed in this country, especially that from your Shanghai and Peking correspondents in the current issue of THE ENGINEER concerning Chinese engineering education, and direct dealing with British manufacturers.

The remark from Peking ventilating the necessity for pegging away quietly "masku" governmental changes, as is done by the Chinese men of affairs themselves, is an absolutely central bull's-eye on the target of accuracy.

Far too much notice is taken of, and importance attached to, political upheavals in China by those in England who wish to carry on to mutual profit the business of development in the Far East.

London, January 30th. CECIL S. HOWSIN.

AIR CONFERENCE, 1923.

PROGRAMME AND OUTLINE OF PAPERS.

First Day, Tuesday, February 6th.—Morning Session (Civil Aviation), 10.30 a.m.: The proceedings will be opened by the Right Hon. the Lord Mayor of London. The chair will then be taken by the Secretary of State for Air, Lieut.-Colonel the Right Hon. Sir Samuel Hoare, Bart., C.M.G. First paper, "The Position of Air Transport To-day," by Major-General Sir W. Sefton Brancker, K.C.B., A.F.C., Director of Civil Aviation, Air Ministry; second paper, "The Establishment of a Self-supporting Airship Service," by Commander C. Dennis Burney, C.M.G., Afternoon Session (Technical), 2.45 p.m.: The chair will be taken by Sir Henry P. Maybury, K.C.M.G., C.B. First paper, "The Progress of Research and Experiment," by Air Vice-Marshal Sir W. Geoffrey H. Salmond, K.C.M.G., C.B., D.S.O., Air Member for Supply and Research, Air Ministry; second paper, "Gliders and their Value to Aeronautical Progress," by Colonel Alec Ogilvie, C.B.E., F.R.Ae.S.; third paper, "Seaplanes," by Mr. C. R. Fairey, M.B.E., F.R.Ae.S.

Second Day, Wednesday, February 7th.—Morning Session (Civil Aviation), 10.30 a.m.: The chair will be taken by the Under-Secretary of State for Air, his Grace the Duke of Sutherland. General discussion on the papers read on the first morning. Afternoon Session (Technical), 2.45 p.m.: The chair will be taken by Sir William Joynson-Hicks, Bart. General discussion on the papers read on the first afternoon.

"THE BEARDMORE NEWS."—We have received from the editor of the *Beardmore News* the 1922 volume of the monthly journal of the Beardmore organisation. This well-produced works magazine not only deals with the various activities of William Beardmore and Co., Limited, at its various branches at London, Parkhead, Dalmuir, Mossend, Coatbridge, Paisley, Anniesland, and Inchinnan, but also chronicles the chief events of interest concerning the associated concerns of Arrol-Johnson, Limited, Dumfries; Duncan Stewart and Co., Limited, Bridgeton, Glasgow; the Dowson and Mason Gas Plant Company, Limited, Lovenshulme, Manchester; F. E. Baker, Limited, King's Norton; and Dunford and Elliot (Sheffield), Limited, of Sheffield and Birmingham. The editorial matter is interesting and is well displayed and illustrated, with a restrained use of colour in headings and capitals. A feature of the magazine is the separate works supplement, dealing with news of topical interest to the individual factories and supplying a record of social and welfare work.

A Seven-Day Journal.

Making Engineering Popular.

VARIOUS efforts, more or less successful, have been made from time to time to arouse popular interest in current engineering events, even although these events may be far removed from having any special significance to the public ni general. For development in this direction it would, we think, be hard to beat an announcement received this week from the Publicity Department of the British Empire Exhibition. A simple statement that the British Electrical and Allied Manufacturers' Association had made an offer to lend the Exhibition authorities plant valued at about £130,000 for installation in the temporary power station would, no doubt, have failed to attract much public interest. It had, therefore, to be expanded upon and embroidered. Accordingly, we are told that the turbine blades will revolve at a speed of 5 miles a minute, and during the period of the Exhibition will travel a total distance equal to twenty circuits of the world with a call each time at every Dominion of the Empire. The coal to be consumed would, if brought in one load, require a train over two miles long, while the steam to be evaporated (*sic*) would flood (*sic*) the Stadium to an extent that would necessitate the Cup finalists playing up to their knees in water. The power to be generated at the station would be sufficient, we are further told, to supply a town of 100,000 inhabitants, or "light a 60-watt lamp every 100 yards on the road from London to Glasgow." On this basis the Exhibition should wallow in Cimerian darkness, for it allows on the average to each house in the imaginary town almost exactly one 20-watt lamp. Perhaps, however, we are meant to understand that something over 98 per cent. of the illumination in the town is effected by means of gas.

Oil Fuel Supply on the Thames.

IT is announced that the well-known Cardiff firm of colliery owners and shippers, Cory Bros. and Co., Limited, is to lay down a large oil fuel installation in the neighbourhood of Canvey Island, on the Essex bank of the Thames. The district is already remarkable for the close proximity of several oil storage depots. At Thames Haven the London and Thames Haven Oil Wharves Company has refining works and storage tanks, while at Purfleet there is the installation of the Anglo-American Company, Limited, and the Shell Company's refinery and depôt at Shell Haven. The site of the new development is known as Kynochstown, and is on the mainland to the west of the creek which separates Canvey Island. It was here that Kynoch's, Limited, built the large munition works which were bought a year ago by Cory Bros. We understand that the locality will now bear the name of Corytown. Preliminary work is proceeding, and it is reported that the contract for storage tanks has been placed with Palmer's Shipbuilding and Engineering Company, Jarrow. Cory Bros. are already oil contractors at Cardiff. It is expected that the completion of the new Thames depôt will cost in the neighbourhood of a quarter of a million pounds.

The Late Hon. R. C. Parsons.

THE death occurred in London last Friday of the Hon. Richard Clere Parsons, elder brother of the Hon. Sir Charles Parsons, and himself a well-known engineer. He was the third son of the Earl of Rosse, the astronomer, and was born on February 21st, 1851, so that he was nearly seventy-two at the date of his death. Studying at Trinity College, Dublin, he gained honours in physics, chemistry and engineering. For a time he was a partner in Kitson and Co., of Leeds, and while in that city helped to develop the Yorkshire College, now the University of Leeds. Subsequently he joined in partnership with Mr. J. F. La Trobe Bateman, and acted as consulting engineer in connection with water and drainage works, principally abroad. He was a governor of the Imperial College of Science and Technology, and a vice-president and manager of the Royal Institution, and was actively associated with the management of King's College, London.

The Therm Inquiry.

THE fifth and last meeting for the taking of evidence by the Board of Trade's Committee on the Therm as a basis of charging for gas consumption was held on Friday of last week. Dr. Carpenter, of the South Metropolitan Gas Company, was the principal witness. He denied the allegation that the therm had been introduced by the companies. On the contrary, many of his colleagues, although not himself, had been opposed to it on the ground that it would cause unnecessary complication. The idea that the gas companies encouraged waste, either by leakage or the employment of uneconomical apparatus, was wrong. Waste was in reality the greatest enemy of the undertakings, for, he was convinced, the greater the economy the greater would be the demand for gas. Gas lighting, he maintained, was as popular as it had ever been. Given the option of gas or electricity, the tenants of new houses in nine cases out of ten would choose gas for illuminating purposes. In connection with a housing scheme at Woolwich only 27 out of 1100 consumers were taking electricity for lighting purposes, although 600 houses had been wired for electricity supply. Another witness, Mr. Vallancey, of Sidcup District Council, urged the provision, free of cost to the consumer, of automatic means on the consumer's side of the meter for avoiding variation in pressures between high and low parts of the district served, and also during times of maximum and minimum demands on the mains. Councillor Rumsey, of West Ham, dealing with the small consumer's side of the question, stated that if the supply were drawn through a penny-in-the-slot meter the cost of cooking was now about 50 per cent. more than it was in the cubic foot days.

Canadian Paper Making Machinery.

SOME time ago, it may be recalled, Armstrong, Whitwoth's entered into a working agreement with Charles Walmsley and Co., Limited, of Bury, Lancs., one of the best known British firms producing paper-making machinery. News has been received this week from Canada to the effect that, following that agreement, it has been arranged by Armstrong, Whitworth, of Canada, Limited, to hand over its plant at Longueuil to a new company, Charles Walmsley and Co. (Canada), Limited. That plant has been closed for some time past, but under the new arrangement it is to be re-organised and re-opened for the manufacture of pulp and paper-making machinery. The existing steel foundry is to be extended, and a grey iron and semi-steel department added to it. The new company has obtained the rights to manufacture the Watford Engineering Company's "Tremor" strainer, and has completed a similar arrangement with Gwynnes, Limited, of Hammersmith, in connection with the manufacture of that firm's designs of centrifugal pumping machinery. In addition to producing paper-making machinery, the Longueuil plant will undertake the manufacture of water turbines, Pelton wheels, hydraulic pumps, lock gates, sluice valves, and similar apparatus.

The Gas Referees' Reports.

THE quarterly reports of the Gas Referees appointed for the London area by the Board of Trade under the Gas Regulation Act, 1920, have been received this week. They show that during the quarter ending December 31st, 1922, all the five companies succeeded in maintaining a pressuure in excess of the minimum 2in. at every testing place. In four cases no trace of sulphuretted hydrogen was found, but in the report covering the gas supply of the Gas Light and Coke Company, it is stated that at one testing place in Hackney traces were found. The chief gas examiner, however, decided "that the fault was not substantial and that no forfeiture should be incurred by the gas company in consequence." As regards the calorific value all the companies succeeded in showing an average figure in excess of the prescribed value, and on no day in the quarter for any period of two hours did the calorific value fall by 6 per cent. or more below the prescribed value. The latter values were the same as for the previous quarter, but the average values realised were slightly different. The prescribed and realised average values were as follows, the figures in brackets being the average realised values for the previous quarter:—Brentford Gas Company, 460 B.Th.U. gross per cubic foot, 464.6 (471.2); South Suburban Gas Company, 460, 481.3 (477.7); Wandsworth Company, 470, 480.5 (479.7); Commercial Gas Company, 475, 488.4 (492); Gas Light and Coke Company, 500, 504.4 (501.6). The report for the South Metropolitan Company has not yet been received.

The East Midland Coal Deposits.

FEARS have repeatedly been expressed that within a few generations the available coal supplies of this country will have shrunk to an extent that will seriously react on our industrial position. It would appear that such ideas in the light of recent investigations are in need of some revision, and that the "expectation of life" of our coalfields has become greater than that at which it has been estimated. In a lecture delivered at the London School of Economics, Sir Halford Mackinder stated that in South Yorkshire, Nottinghamshire and Leicestershire, easily worked deposits of coal were now known to exist and to extend over hundreds of square miles. The deposits, he said, were sufficient to insure a supply of 10 to 12 million tons a year for more than 400 years, and were such as to justify the expenditure of 20 million sterling of capital within the next few years in opening up the area. He foresaw the time when Goole, Hull, Immingham and Grimsby would become virtually one huge port serving the area. The approximate limits of the new coal bearing area were subsequently specified by Sir Halford as lying within the region defined by the river Trent and a line passing from Nottingham through Mansfield, west of Doncaster to Selby.

Centralising London's Electricity Supply.

A PRIVATE Bill is to be introduced into Parliament during the coming session by the London Electricity Joint Committee (1920), Limited, with the object of promoting the co-ordination of electricity supply in London. The committee is composed of representatives of the Brompton, Charing Cross, Chelsea, London, Metropolitan, Kensington St. James, Westminster and Central Electric Supply Companies. Since the inquiry before the Commissioners in 1921, the local authorities and the companies have resolved that development would be best secured by the formation of one body representative of the companies, and of another representative of those local authorities which undertake their own supply of electricity, the generation of electricity to be centralised in each case in the hands of the respective bodies. In the Bill it is proposed, *inter alia*, that the right of purchase by the London County Council of the undertaking of the committee shall be postponed until 1971. After January 1st, 1932, a sliding scale is to come into operation under which the constituent companies are to receive a standard cumulative dividend of 8 per cent., subject to an increase according as the revenue obtained is less than that which would have been obtained had the maximum price for the supply been charged.

Prevention of Accidents in Mines.

IT is announced that the proprietors of the *Colliery Guardian* have decided to offer two prizes, one of ten guineas, the other of five, for the best designs or suggestions having for their object the prevention of accidents in the haulage roads of mines. The competition closes on May 1st, and is limited to *bona fide* working miners or officials up to and including the rank of deputy. Should the competition prove a success, it will be followed at intervals by others covering other phases of the problem of securing safety in mines. Next to falls of roofs or sides, a type of accident which in 1920 caused 544 deaths, or at the rate of 0.55 per 1000 persons employed underground, haulage accidents, with 237 deaths in the same year, are the most fruitful source of mishaps in mines. At the same time, it is also the class which probably yields most readily to the use of effective appliances, and it is hoped that the competition will produce some appliance or appliances which will be worthy of adopting on an extensive scale in collieries.

Sixty Years Ago.

IN a paragraph in our issue of January 30th, 1863, we read that according to the latest returns, the total number of locomotives then at work on the railways of Great Britain and Ireland was 6156, and that "assuming that the average cost of each was £2500, the capital invested in them would be no less than £15,390,000." To-day it is interesting to note the number is approximately 24,400, excluding electric locomotives. The number of railway engines in England and Wales has increased by more than 400 per cent., in Scotland by just over 350 per cent., and in Ireland by less than 250 per cent. The appointment was recorded of Mr. (later Sir) E. J. Reed as chief constructor of the Royal Navy. Naval education in those days was apparently largely in the hands of the clergy. Mr. Reed, it was recorded, was specially selected when at Sheerness by the Rev. Canon Moseley, for removal to the School of Mathematics and Naval Construction at Portsmouth, and there studied the highest branches of naval architecture under the Rev. Joseph Woolley. The Institution of Naval Architects owed much to Mr. Reed. The whole project for its formation, we find it stated, was made dependent upon his acceptance of the post of organising secretary. The loss of the Monitor on December 31st, 1862, in a storm off Cape Hatteras, when being towed by the steamer Rhode Island, was described. Of the two crews twenty-four were drowned. The commander of the Monitor, Captain Bankhead, was firmly of the opinion that the vessel sprang a leak in the forward part where the hull joined the armour, as a result of the heavy pounding upon the sea. In the correspondence columns Mr. David Kirkaldy replied to the somewhat severe criticism passed by Dr. W. C. Unwin in our previous issue, upon the manner in which he had presented the results of his experiments on the strength of wrought iron and steel.

Some Notes on Old Windmills.*

By ARTHUR TITLEY.

THE origin of windmills is very obscure. Unlike water mills, they appear to have been unknown to the ancient Greeks and Romans. Although it is probable that they were introduced into Europe from the East, the often-repeated statement that they were brought by, or followed, the Crusaders, is uncorroborated.

The first definitely accepted reference to a windmill in England appears to be that contained in the Chronicle of Jocelyn de Brakelond (1437), which describes the building of one by Dean Herbert on his glebe land at Bury St. Edmunds in 1191, and, by order of Bishop Sampson, pulled down.

The first illustration of a windmill in this country that we can approximately date occurs on a brass, probably Flemish, at King's Lynn, upon the tomb of Adam de Walsokne, merchant and Mayor of Lynn, who died in 1349. This shows a post mill of a similar type to that which can be seen working to-day. The post which carries the mill is fixed at the junction of two horizontal timbers crossing each other at right angles upon the ground. Inclined struts are framed to these timbers and to the post, the whole forming a rigid structure. Wide steps at the back of the mill give the means of entrance to it, and a horizontal beam centred on the post and passing through the steps enables the miller to turn the mill bodily round to face the wind.

In 1588 Ramelli published his work "Le Diverse et Artificiose Machine." Here we get our first view of the internal economy of a windmill, for Ramelli brings us at once into the realm of practical mechanics, and we are enabled to see a complete mill in much the same state of development as that in which Smeaton found it in the middle of the eighteenth century. Ramelli shows us a post mill—Fig. 1—with its post frame placed upon four blocks of masonry upon the ground. The tailbeam is provided with a windlass, a rope from which fastens to any of a row of posts driven into the ground in a circle round the mill, while a frame and wedges raised the steps from the ground while the structure is being turned to the wind. He also shows us a tower or smock mill—Fig. 2—which became possible by the invention of the rotating cap, which, according to the Flemish writer, Leeghwater (1575–1650), was due to a Fleming in the sixteenth century. The engraving shows the cap carried on vertical rollers centred in the moving curb upon which the cap is constructed. Horizontal rollers guide it in a circular path. This method is the one most used in England to-day. Ramelli gives a third picture—Fig. 3—showing a tower mill driving two chain pumps. On the wind shaft are fixed two lantern pinions which engage the chains. The whole pump construction is hung from the rotating cap and its lower end dips into a well in the base of the tower, from which the water is lifted to a circular tank at the top of the tower.

All the framing and gearing of these mills are of wood, the only important parts of iron being the wrought iron gudgeons upon which the shafts revolve, and perhaps the "quants" or spindles which drove the runner stones. A simple wheel and axle hoist, operated by hand, assisted the miller to raise the sacks of corn to the floor upon which the stones were situated. An exceedingly interesting feature is here exhibited in the brake embracing the wheel upon the wind shaft, by which the mill was stopped when required. A band surrounding this wheel is attached at its free end to a lever. This lever is weighted so that normally the brake is on. A rope passing over a sheave in the cap enables the end of the lever to be raised by means of a winch when it is necessary to release the brake. Here we see the underlying principle of all modern safety devices understood and applied by the millwrights of Tudor days.

D'Acres' "Art of Water Drawing," published in 1660, contains an interesting reference to windmills, which is worth quoting as showing considerable appreciation on the part of the author of the principles involved. He says:—

"*Instruments* peculiar to the *wind* in making *motions*, are only *sayles* as yet in use; and these are of three *sorts*, differing chiefly in their *posture* and the manner of placing them. The first sort are *hanging downright*, the other, set *level*, the 3 sort *screw wayes*. The first sort (being *perpendicular*), are the most usual and best, being commonly used in corn mills. The other sort call'd horizontal sayles are of little use and lesse worth, they will move, but not Equalling the strength of one *horse*. Some of these are made to go with *shrouds* or *shelters*, others without: those without *shrouds* give a *broad side* to the driving *wind*, and come more closely up against the wind, the sailes falling off at the utmost Ends, or closing together: either of these wayes hanging upon *Iron Gimbals*, are subject to sudden breaking in great winds; and also in danger the *Gins* set to them by their sudden *Girts* that every sail gives when it takes the wind with the *broad side*; and are therefore not in use in moving water *Gins*.

"The other sort of *Horizontal Sailes* with *shrouds*, move more quietly, but with no worthy strength, though the one half be shrouded never so well, as experience hath taught. The reasons may be these; the commanding sailes in the wind are but two at the most, and but one of them sometimes in full Strength. Then on the other side, though the *shrouds* may keep blasting *winds* away, yet neither it, nor anything else, can keep the *Air* away, and the sailes coming up against it with broad sides, receive thereby such a shock, as cannot be recovered by the other Side.

"The third sort of *sailes* are placed *screwwayes* upon an axis lying *horizontally*, as if *sailes* were fixed upon such an axis as a *shaft* of a wheel, (a little winding about the axis like a screw, but not much), the whole length of the axis, so that which way soever the wind cometh, except upon the two *poynts* or ends of the *axis*, the *sailes* are in readiness to receive it; all the nether part of it from the *Center* of the *Axis* downwards, is shrouded, as the horizontal sailes. These, (as some conceive), perform better service than the *horizontal sayles*, but not so much as the *perpendicular*."

Our next information, and by far the most important, is contained in the works on millwrighting published in Holland in the early part of the eighteenth century. Of these, three—"Arch. Mech. of Moole-Boek," Pieter Linpereh, Amst., 1727; "Groot Volkomen Moolen Boek," Van Natrus and others, Amst., 1734; "Theat. Mech. Univ. of Groot Alg. Moolen Boek," Johannis Van Zyl, Amst., 1734—were published in Amsterdam in 1727 and 1734, which contain scale drawings of complete mills, from the inevitable piled foundation needed almost everywhere in Holland, to the auxiliary machinery which had by this date been considerably developed. In examining these books our attention is called to a conservatism in design and an elaboration of detail which clearly indicates that the art of windmill building in Holland had by this time passed through a long period of evolution, and had arrived at definite

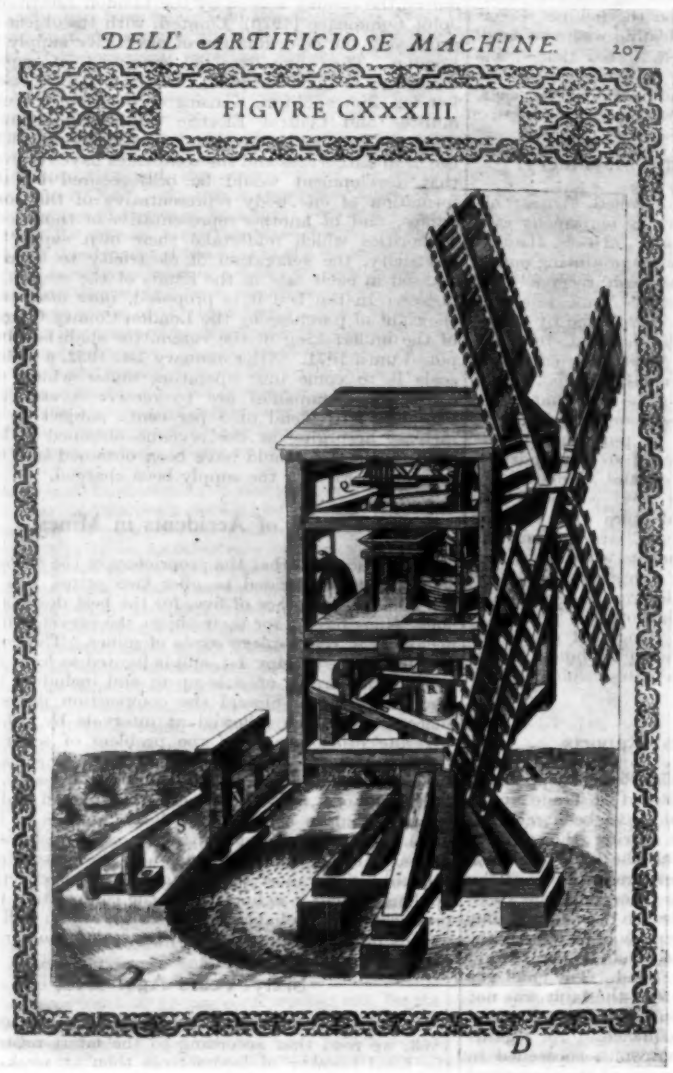

FIG. 1

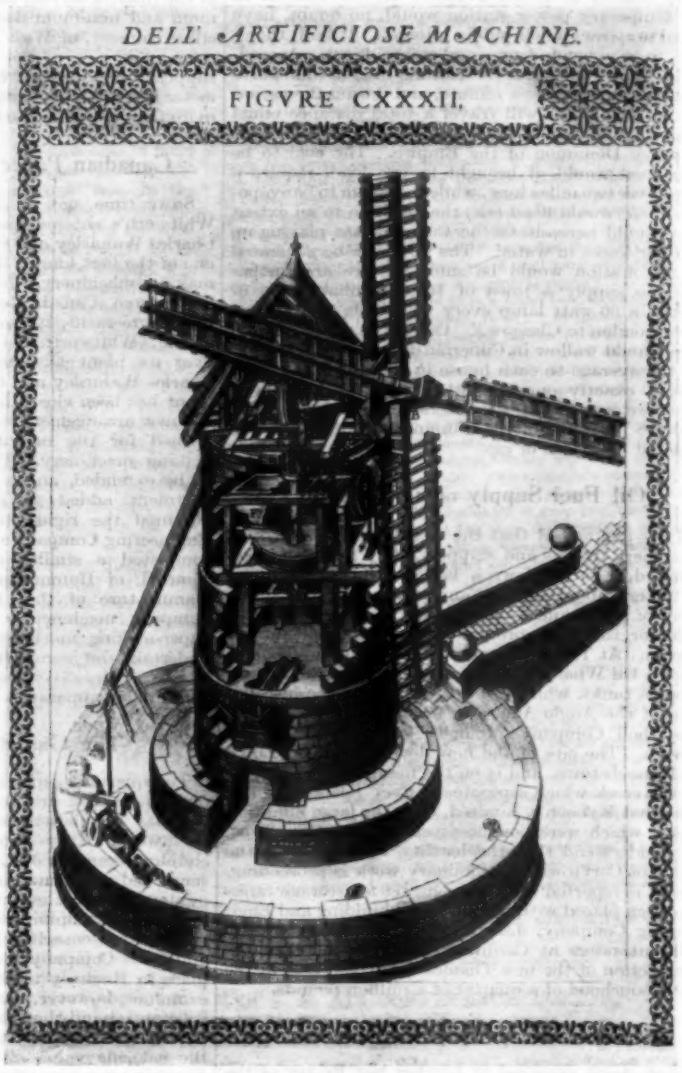

FIG. 2

* The Newcomen Society for the Study of the History of Engineering and Technology. Read at Queen's College, Birmingham, on January 26th, 1923.

and accepted practice. We find full details of the way in which the framed wooden towers were built and erected, and of the sails, shafts, and gearing. We see grinding mills for various grains, fulling and paper mills, mills for grinding snuff and cutting tobacco, for beating hemp, sawmills and mills for grinding and boring gun barrels, besides mills for driving scoop wheels and archimedean screws for pumping water. We can study here their methods of mortising and tenoning the framework together, of setting out the teeth of wheels, and of building up wheels, shafts and other mill work parts; while even the tools they used and the capstans, tackles and lifting jacks they employed in the erection are illustrated.

Timber still remained the principal material from which they made their machinery. The drawings clearly show how their massive shafts and wheels were constructed. A particularly interesting picture shows that in making such a piece as the wind shaft the first process, after squaring the log sufficiently to obtain true surfaces to work from, was to carve out at each end a cylindrical projection or spigot upon which to rest the shaft and rotate it on temporary bearings so that it could be further wrought to a true form. The permanent journals were thus reduced to a circular shape, and in order to provide a wearing surface iron bars were let longitudinally into the journal and held in position by wrought iron rings placed on the ends of the bars. The illustration shows two millwrights at work fitting these bars into the recesses prepared to receive them. The spigots formed upon the ends of the shaft were usually left upon it so that the shaft could be truly rotated when any repairs to it were needed. This method of giving a metallic bearing surface to a timber shaft is probably very ancient, although I have found no earlier reference to it. It remained in use till the adoption early in the eighteenth century of cast iron gudgeons with what is called a "cross-tail," by which they were attached to the timber body of the shaft, and it survived late enough to be carried to the United States, where it is recorded as existing in a windmill on Cape Cod. Cast iron appears to have been commonly used for smaller parts of mill work by the beginning of the eighteenth century, and many parts of this material are shown in the Dutch drawings. For instance, the ratchet wheels used for feeding the log through the gang saws in the sawmills shown are evidently of cast iron, and the gun barrel mill illustrated has two of the smaller shafts also of cast iron.

The bearings upon which shafts turned were probably of hard wood. Such bearings were in use for water-wheel shafts as late as 1784. Stone also was frequently used, and Van Zyl illustrates one such bearing in his book. Metal "brasses" were also used, and the same author shows a lower bearing fitted in a timber "headstock," which he describes as "Hals metaal" (neck brass). A derelict post windmill at Warton, in the Fylde district of Lancashire, had stone bearings of what, according to a local writer, was known as "blue boother stone," and the late Mr. Sidney Russell has recorded that South of England millwrights used "Nottinghamshire block" for the same purpose.

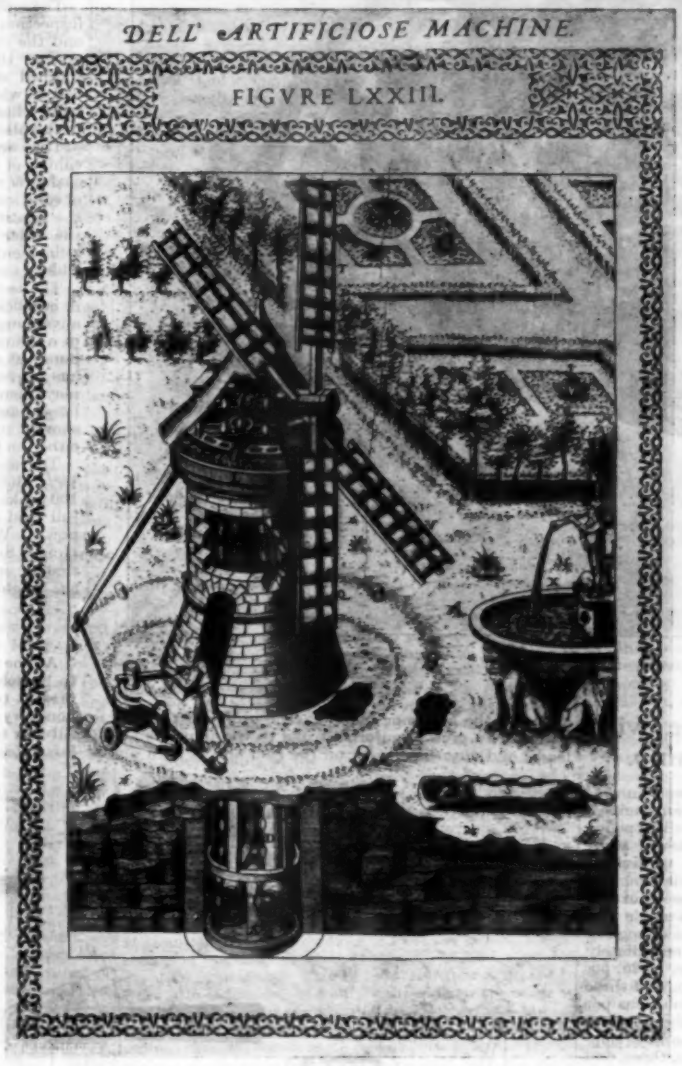

FIG. 3

The auxiliary machinery shown in these drawings of Dutch mills would form a useful subject for study to anyone investigating the history of the various industries dealt with.

From what we can see up to Ramelli's day, the sails of a windmill were placed at a constant angle of "weather" to the sweeps which carried them. When we come to the Dutch works we find the idea of fixing the sail bars at a decreasing angle to the plane of rotation from the centre of motion in proportion to their circumferential velocity was fully understood, and they show us the method of setting out the proper angles of the mortices through which the sail bars passed. The method of trimming the head of the mill to the wind was usually that shown in the fourteenth century pictures in Green's "History." A winch attached to the tail beam was used in the same way, though Pieter Linperch gives us a case in which a Y-wheel, as it is still called—from the shape of the irons attached to its rim—and rope were used to give motion to a trundle gearing with an internal circular rack upon the cap, so that the head could be rotated from within the mill. A similar arrangement is to be seen in the Chesterton mill visited by members of the Society at the Birmingham summer meeting, but in this case a winch in the head gears into a fixed rack inside the tower.

An excellent detail developed by the Dutchmen, which appears to have been generally used by them, was the mounting of the pins upon which the anti-friction rollers carrying the cap turned upon a "roll ring," as it was called, so that the weight of the cap was transmitted through the rollers direct without being borne by the pins. Smeaton, who visited Holland for the purpose of studying their mill practice, introduced this feature into English mills, although it does not appear to have been adopted here to any extent.

Windmill construction in Holland appears to have reached its perfection at about this period. The automatic arrangements for controlling the sails and for keeping the head to the wind, invented and applied in England at a later date, never appear to have been adopted there, as any modern view of a Dutch landscape shows, but the elaboration of detail and excellence of construction has probably never been reached outside Holland. Indeed, an examination of their published works impresses the reader with the great debt that industry owes to the practical and industrious Dutch millwright.

About the year 1750 the Scotch millwright, Andrew Meikle, to whom we owe the threshing machine, invented the "fantail" gear for automatically keeping the head of the mill to the wind. In this gear a small windmill placed at the back of the cap at right angles to the main whips, is geared with a reduction of about 3000 to 1 to a circular rack fixed outside the top of the tower. This arrangement has been very largely used in England, the chief later development of it being the use of iron spur and bevel gear, whereas Meikle originally used worm gear. Wood worm gear has been frequently used and, I believe, examples are still in use.

Smeaton devoted much attention to windmills, and about the year 1755 introduced cast iron wind shafts and cast iron spur and bevel toothed rings in place of the usual wood mortice wheels, and in 1759 carried out his well-known experiments, in which he investigated the relation between wind velocity, horse-power, sail area, and angle of weathering, and in which it is noteworthy that he substantially confirmed the results at which the Dutch millwrights had arrived by practical experience.

Andrew Meikle, about 1772, invented an arrangement for automatically relieving the sails of windmills from excessive wind pressure. This he did by dividing the sail area into unequally pivoted divisions placed at right angles to the length of the whip, coupled together by a rod to a spring fixed on the sweep near the centre. The tension on the spring could be regulated by means of nuts on the outer ends of the bars when the mill was stopped, each sweep being adjusted separately. A modification of Meikle's arrangement is in common use in English mills to-day.

No account of the machinery of a windmill would be complete without reference to the "lift tenter," which in Watt's time reappeared as the governor. The origin of this has not yet been cleared up, but it was devised to automatically raise and lower the runner stone in corn windmills as the force of the wind and the speed of the mill varied, taking the place of the balance arrangement clearly shown in Rees' picture of the internal economy of a post mill, by which the height of the stone was adjusted by hand.

The "tenter" seems to have been unknown to the writers of the Dutch books, and I am not aware that Smeaton ever referred to it. It was therefore probably introduced towards the latter end of the eighteenth century. Although it was patented by Thomas Mead (No. 1628 of 1787) and by Stephen Hooper (No. 1706 of 1789), it was probably in use before that date. In the form illustrated by Mead the suspension joints of the pendulums are at right angles to those of the steam engine governor—that is, the weights rose under the combined influence of "lag" and centrifugal force. Buchanan (1814) shows this form of "lift tenter," and I have met with four existing examples of it. One was working in a large eight-armed mill at Heckington, in Lincolnshire, which has the date 1830 upon the tower. The "tenter" referred to, however, was evidently acquired with a pair of stones, which it governed, from an older mill. In this mill there are four other pairs of stones all governed by a "tenter" of the governor type, the steelyard levers of three pairs being coupled to the fourth, which engaged with the rising collar of the tenter. Quite commonly several pairs of stones are to be seen thus controlled. The "lift tenters" are often attached directly to the quant or mill spindle, but are sometimes driven by belts from the vertical shaft of the mill, with an intermediate spindle to enable the speed to be increased. At Stafford, near the tower of a disused mill, the name is perpetuated in "Tenter-lane." Attempts were made at the latter end of the eighteenth century and the beginning of the nineteenth to govern windmills by automatically increasing or decreasing the area of canvas sails, but these attempts do not appear to have been successful. Stephen Hooper, in the patent cited above, describes such an invention. John Bywater (No. 2782 of 1804) patented a roller reefing gear in which a hit-and-miss arrangement allowed the sweeps to be reefed or unreefed from inside the mill. These devices do not seem to have had any success, although I have met with one mill in Lincolnshire using roller reefing gear with hand control upon each whip separately.

In 1807 (No. 3041), William, afterwards Sir William Cubitt, patented an improvement upon Meikle's reefing gear with opening louvres, in which he brought the controlling rod through the centre of the wind shaft to the back of the cap, where a weighted lever is raised automatically as the louvres open under the pressure of the wind. This gear and Meikle's fantail for keeping the mill to the wind have been very extensively used in this country and can still be frequently seen.

The horizontal mill never found favour with the Western miller. The reasons, no doubt, were those so clearly set forth by the author of "The Art of Water Drawing," quoted above. The idea, however, has always been a favourite one with the inventor especially of the amateur kind; we find allusions to it as far back as the sixteenth century, and the work, by W. H. Ryff, published in Nuremburg in 1547, shows a small illustration of one as an inset to a plan of a town. Two illustrations are also to be seen in the William Reynolds' scrap book, one of which, by the Chev. de Betancourt, is taken from Proney's "Architecture Hydraulique." The Journals of James Watt (Watt papers at Doldowlod) contain the following:—"April 11, 1779. Sunday at Lichfield with Mr. Wedgewood—to see Dr. Darwin's horizontal windmill," so that the ingenious doctor was evidently attracted by the problem. The most ambitious attempt, however, was that of Stephen Hooper, who erected a corn mill on this principle at Margate, for which he obtained a patent. This mill is shown in Rees' Cyclopædia. It was still working in 1820. The vanes of the mill were screened by a circle of boards after the manner of turbine blades. Another of Hooper's mills was built at Battersea for grinding linseed, but was described in "The Ambulator" in 1811 as having been by that time converted to a malt mill.

RESUMPTION of work on the Esquimalt dry dock, Victoria, British Columbia, has been formally ordered by the Minister of Public Works. The work is expected to be completed about June, 1924, and will cost a total of 1,500,000 dollars.

100-B.H.P. HOT BULB OIL ENGINE.

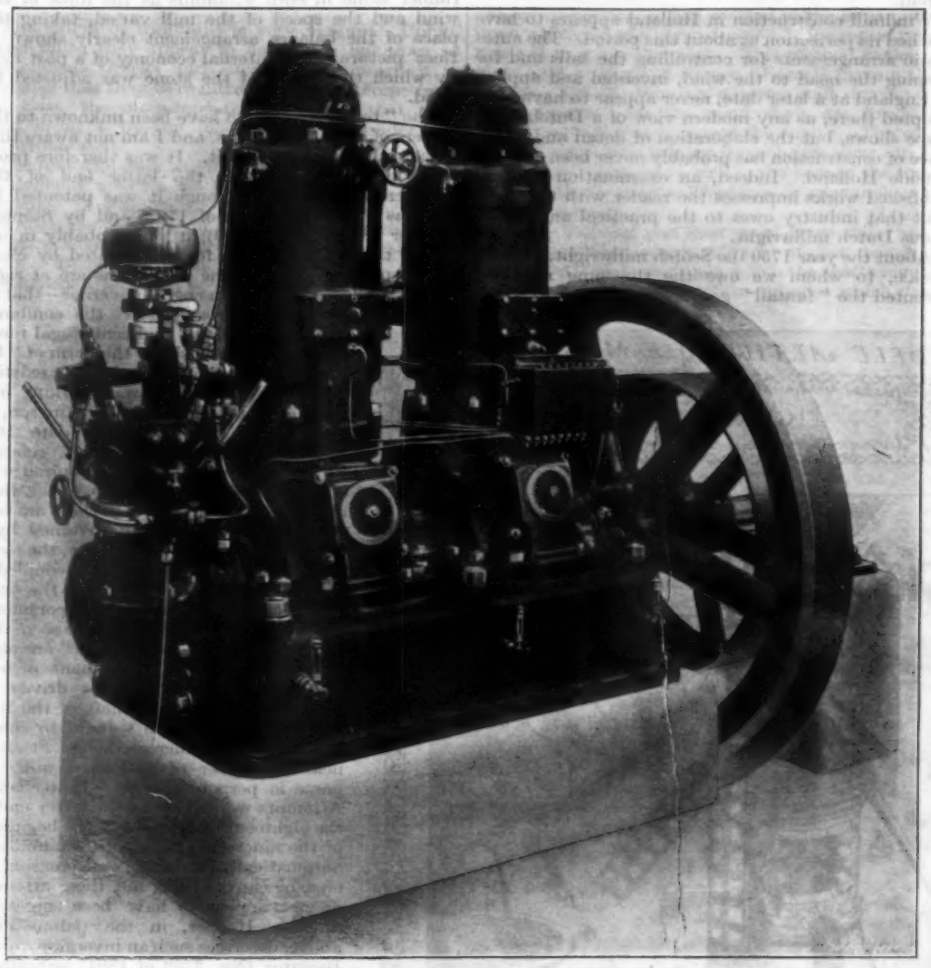

FIG. 1

A Belgian Hot Bulb Engine with the R.E.M. Type Fuel Pump.

THE Anglo-Belgian Company, of Ghent, is well known, among continental builders of internal combustion engines, for the series of heavy oil engines of the hot bulb type, of which it has made a speciality. For purposes of standardised manufacture the range of engines is divided into four series. The first two series include small engines of 10 to 30 horse-power designed to run at speeds of 450 and 425 revolutions per minute, and built as single and two-cylinder units. The third and fourth series of engines with which our present article is more immediately concerned, comprise engines in the third series, of 25, 50, and 75 horse-power, built in units of one, two, and three cylinders, and designed for a speed of 380 revolutions per minute, while the fourth series embraces the three largest sizes, running at 280 revolutions per minute and developing 100, 150, and 200 brake horse-power on two, three, and four cylinders respectively. The illustration we reproduce in Fig. 1 shows a 100 brake horse-power two-cylinder unit for stationary work. A marine type of engine with combined clutch and reversing gear is also built in sizes corresponding to the first, second, and third series of engines already mentioned. Dealing briefly with the general characteristics of the engine, we note that in general design it approaches closely to the accepted lines of construction for heavy oil engines of the hot-bulb type. Crank case compression is employed, and the cylinders are mounted on short crank cases which form an intermediate member between the cylinder casing and the bed-plate. Generally speaking, the engine is characterised by a robust construction, and the cylinder dimensions are amply rated, giving a normal 10 per cent. overload capacity, while the speeds are, if anything, higher than the average, which is an advantage from the point of view of electric generating driving. The water-circulating pump is of the marine plunger type, and is excentric driven from the main crank shaft, and is fixed to the bed-plate adjacent to the fly-wheel. The main bearings are ring lubricated, and the other parts of the engine are mechanically lubricated. The special feature of the engine is the R.E.M. type of fuel pump, which is fitted to all engines above 50 horse-power, and is seen in the illustration reproduced in Fig. 1. This pump, which was designed by Professor R. E. Mathot, and is further illustrated by the sectional elevation and plan of the drawing reproduced in Fig. 2. The vertical design has solved the difficulty of arranging three or four pumps around a horizontal axis in combination with a governor, which is often met with in governors of the crank shaft type for multi-cylinder engines. The vertical governor spindle is directly driven from the crank shaft through spiral gearing, and the bottom of the spindle runs in substantial bearings of the ball thrust type. The centrifugal action of the governor lifts the lower sleeve A, which carries a specially prepared cam race on which the roller B operating the fuel suction control valve C presses. The main fuel pump plunger D is operated by the cam roller E, which engages with a horizontal rotary cam R keyed to the governor spindle. The profile of the cam is designed to give a uniform stroke to the plungers at all loads, and any slight wear on the cam affects each pump in the same way, avoiding the necessity of individual pump adjustment. The suction valve C, already referred to, is normally in the open position, and on the downward stroke of the main plunger oil is drawn into the pump body. On the upward delivery stroke of the plunger oil is forced back into the suction chamber and piping until the valve C is closed by the roller B dropping into the hollow cam A, when delivery of fuel to the cylinder takes place through the ball delivery valve F. A starting lever G, shown in the normal running position in the centre gate of the quadrant H is provided for starting and priming the engine, and for stopping it. For the purpose of priming the engine, the lever G is moved into the top notch of the quadrant, which moves the cam A in a downward direction and allows the roller B to recede into the neck of the cam automatically closing the suction valve C. This operation having been carried out, each individual fuel spray valve may be primed by means of the priming handle shown at K. When the priming is finished the priming handle returns to its normal position. In order to stop the engine the lever G is moved into the lower notch of the quadrant, causing the cam A to be raised into a position in which the roller B coincides with a circular part of the cam. In this position the fuel suction valve is held open, and no fuel passes to the delivery pipes, all oil being returned through the by-pass to the fuel tank.

The main body of the fuel pump is provided with circular inspection holes, allowing access to the cams and rollers, and the casing is so arranged that it may be rotated in around the centre vertical shaft. For this purpose a toothed segment is attached to the lower part of the casing, which engages with a worm wheel and a controlling hand wheel. A section of the wheel and segment is shown in the plan view of the pump reproduced in Fig. 2.

The arrangements we have described permits the timing of the injection to be advanced or retarded as the casing is rotated in the direction or against the direction of rotation, the movement of the fuel pump casing altering the relative positions of the horizontal rotary cam R and the roller E. For alternating current working a further refinement is the hand speed control fitted to the governor, which is very useful for stepping in machines.

The tests made with the R.E.M. fuel pump show that it is efficient and produces good atomisation, while the advancing and retarding of the ignition can be effected in a manner similar to a motor car. The working of the pump at different loads and with various grades of fuel has proved very satisfactory, and as evidence of this we may mention that a recent inspection of a 100 brake horse-power engine which had been run for twelve months showed that practically no carbonisation had taken place either on the piston or in the combustion space.

The engine illustrated in Fig. 1 has cylinders, each of $14^{3}/_{16}$ (360 mm.) bore by $15\frac{3}{4}$ (400 mm.) stroke, and develops 100 brake horse-power at 280 revolutions per minute. The full load fuel consumption is 0.505 lb. per brake horse-power. We have to thank Mr. Edgar W. Dorey, of Norwich House, Southampton-street, W.C. 1, for some of the particulars we have given. Mr. Dorey is the sole agent for the Anglo-Belgian Company for the United Kingdom.

AT the meeting of the Institution of Electrical Engineers to be held on Thursday, February 1st, the President will present to Mr. J. W. Meares, C.I.E., M.I.E.E., late local honorary secretary of the Institution in India and Electrical Adviser to the Indian Government, a salver and cigarette box subscribed for by his friends in India on the occasion of his retirement from the Indian Government service, and as a token of his valuable services to the profession in India.

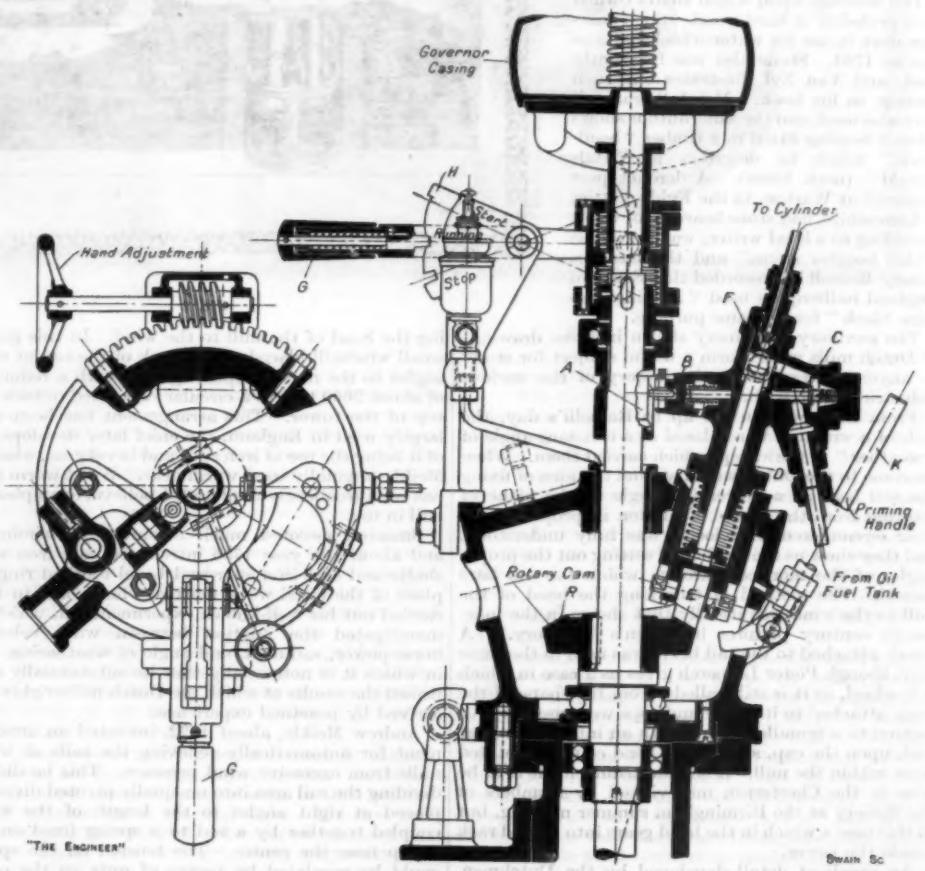

FIG. 2—SECTIONS OF THE R.E.M. FUEL PUMP

Railway Matters.

THE derailment outside Croydon, mentioned in this column on November 17th, is said in Major's Hall's report to have been due to the driver of a local train over-running his signal in a fog. The train was consequently derailed at a movable crossing.

THE report of Major Hall on the derailment on October 30th of an express from Blackpool, mentioned in our issue of November 3rd, shows that it was due to a fractured rail. The mishap had no relation to the water troughs; that the derailment happened there was a coincidence.

THE fog about the middle of last November was responsible for three accidents which have been inquired into. One was on the 16th, at Retford, when, owing to a mistake in the block signals, a second train was admitted into the station without the driver being warned that another train was at the platform.

THE collision at St. Enoch Station, Glasgow, on October 6th, mentioned in this column on the 13th idem, was, according to Colonel Mount's report just issued, due to the signalman changing his mind as to the road the passenger train should take. The driver had seen the signal "off," and then it was thrown up in his face, the road reversed, and the train turned on to a line where a light engine was standing.

IN the carriage and wagon departments on the London, Midland and Scottish Railway Mr. R. W. Reid, of the Midland Railway, has been made the carriage and wagon superintendent, and remains at Derby; Mr. A. R. Trevithick is the divisional carriage superintendent (Wolverton); Mr. W. H. H. Warneford is the divisional wagon superintendent (Earlestown); and Mr. F. E. Gobey the divisional carriage and wagon superintendent (Newton Heath, Manchester).

Two additional six-car trains of the pneumatic door type have been put into service on the Piccadilly line. This modern type of rolling stock has met with much public favour, affording as it does 65ft. of doorway accommodation, as against 25ft. in the older type of car. Apart from the advantages these new cars possess in relieving congestion both in the train and on the platform, the customary noise from the slamming of doors and gates and the ringing of bells and whistles is also abolished. The pneumatic doors close silently, and, on closing, automatically give to the driver an optical signal.

THE report of the chief engineer as to the new works carried out on the Great Eastern Railway last year was not received in time to be incorporated in our annual article. The only work of note was at Lowestoft, where the reconstruction of the north quay alongside the London end of the goods yard was completed and the gaps which formerly existed were eliminated. We are told that 1683ft. of quay are now open for traffic. Improved sidings and connections have been laid down, and a wide cartway for serving them is partly completed. Much improved accommodation for vessels is thus provided for loading, discharging, bunkering, and fitting out.

THE local Councils referred to in this column on the 19th ultimo will be part of the arrangements necessary under Section 24 of the Railway Act, which ordered two panels to be set up. One, to be known as the general panel, will have thirty-six members, of which twenty-two are to be nominated by the Board of Trade after consultation with such bodies as are considered to be most representative of trading interests. This question is causing some heartburning in the West Riding of Yorkshire. The proposal of the Railway Tribunal is understood to be that the North of England should be one area. The West Riding people, in general, think that there should be a West Riding area. Leeds and Bradford go further; they want an area of their own.

THE Turin correspondent of the *Economist* states that the newly appointed Extraordinary Commissioner for State Railways is determined to dismiss 50,000 railwaymen, and that nothing short of such a drastic measure can save the railway budget. The increase in the number of railwaymen was 39 per cent. after the war. While the number of men employed increased, the work done diminished. Train-kilometres diminished from 153.7 millions in 1913–14 to 129.5 in 1921–22. An application of the policy of the eight hours' day, and of the weekly rest, by which the hours of effective work done were sometimes reduced to two or three hours a day, is largely responsible for this lamentable state of affairs; but lack of discipline contributed no less to it.

ADDRESSING a dinner of stationmasters on the Brighton section of the Southern Railway, Sir William Forbes said that notwithstanding all that the evangelists of standardisation and centralisation might do, the Brighton system would retain its distinctive characteristics. As to his personal connection with the new Southern Group, he realised that after half a century of strenuous work in the railway world, he could not undertake the heavy responsibility in such a large combination; but he came of an old railway stock—his father was a manager at thirty-two years of age, and his uncle, James Staats Forbes, was one of the railway kings of the Victorian era—and he hoped to continue his association with the old Brighton line, the staff of which he regarded as a family party.

A CONTRACT for the electrification of a portion of the Mexican Railway, a British corporation, has been allotted to a United States electrical firm. The first portion of the track to be electrified is the mountain section between Orizaba (82.6 miles) and Esperanza (111.8 miles from Vera Cruz). The former station stands at an altitude of 1228 m. (4028ft.), while the second is 2452 m. (8044ft.) above sea level. The entire climb from the coast (Vera Cruz) to the city of Mexico, on the Central Tableland, reaches an elevation of nearly 2240 m. (7349ft.), while the highest point on the line is Acocotla, between Apazaco and San Marcos, at an elevation of 8310ft. above sea level. The cost of the electrification of the mountain section is estimated at £1,500,000, while further schemes, including the construction of a line from the rich mining district of Pachuca to Tampico, the latter being the shipping port for the Tamaulipas petroleum fields, may absorb a further £1,000,000.

Notes and Memoranda.

IN the course of a paper on the pitches used in the manufacture of fuel briquettes, read before the Society of Chemical Industry, Mr. A. Grounds said that he did not think enough notice was taken of the different qualities of coal and binders used. The binder should be a medium, soft, coal-tar pitch. Low temperature pitches had a very low, free-carbon content, but were not as good binders as the higher pitches. Those were best from coke-oven tar, and pitches from vertical retorts were better than from horizontals. The ash of pitch should be below 0.05 per cent., though it would often be found to be 0.07. The twisting point should be 52 deg. to 55 deg. Cent. The melting point came out very consistently, but the twisting point was subject to great variations.

THE methods of the artists who produced the remarkable series of brass-casting at Benin are illustrated in a paper by Mr. L. W. G. Malcolm, published in the January issue of *Man*. Mr. Malcolm found the art confined to the area in south-west Adamawa, the principal towns being Bamum and Bagam. As a rule, the material now used is of European origin. In the north it appears that tin was formerly brought from northern Nigeria, and it has been suggested that copper may have come from the Katanga area of the Congo. In all cases the casting is done by the *cire perdue* process. The articles produced by the Eghap tribe are generally pipe bowls, personal ornaments, grotesque animal and bird forms, perfume flasks and bells. Several interesting examples of tobacco pipes used by the Eghap head-men are illustrated by Mr. Malcolm.

IN the *Revue Générale de l'Electricité*, A. Turpain tells of an unusual fatal accident from electric shock. Wires used for radio-telephonic communication between two stations on a distribution network ran parallel to the high tension lines at a distance of 1.80 m. from the latter. On cutting one of these wires a workman received a fatal shock, notwithstanding the fact that the wire was isolated from any source of current and did not touch the high-tension line either before or after being cut. The author attributes the mishap to a capacity effect, current being induced in the circuit—containing the capacity and including the workman—by the 15,000-volt current in the adjacent lines. He maintained that workmen should not be allowed on structures carrying high-tension lines until the latter have been disconnected, even though work is not to be done on those lines themselves. This precaution is particularly necessary when work is to be done on lines running parallel to the high-tension lines for some distance.

THE following method has been suggested as a means of keeping the interior of balloon hangars at as low a temperature as possible. If the outside of the tent is covered with a highly reflecting substance, such as white paint, while the inside is covered with aluminium paint, the radiation into the interior of the tent may be reduced at least 78 to 81 per cent. The reason why this method of painting has this desirable effect is that the white paint reflects the sun's rays, while the aluminium paint is a poor radiator of the long wave-length heat rays. Of course, it must be remembered that this scheme for painting tents would have just the reverse effect at night, and would prevent the heat on the inside of the tent from escaping into the cooler air outside. This same work proves that aluminium paint is the poorest possible kind of coating for heat radiators in houses, at least from the point of view of obtaining the greatest amount of heat from a given surface, since the aluminium paint has a tendency to keep the heat inside and not allow it to escape into the room.

THE penetration of the earth's surface by radio waves is the object of a series of experiments being carried on by the Pittsburg station of the United States Bureau of Mines, in an effort to perfect its life-saving system. The idea is the development of a radiophone that will allow rescuers to communicate with entombed miners when all other means of communication have been cut off by explosion or other accidents. The Bureau has found that signals from a broadcasting station 18 miles from the mine were recorded by a receiver situated inside the mine, and that it was possible to send and receive messages underground through the strata. About 50ft. from the receiving station in the mine was a 6in. bore-hole from the surface, lined with iron pipe and containing electric light wires which extended throughout the mine. The presence of these wires, the report of the engineers said, evidently assisted greatly in the reception, for when the receiving set was carried to another part of the mine removed from the wires the signals were barely audible through 50ft. of cover. The fact that the signals were detected, however, even though faintly, was taken as sufficient evidence of transmission through the ground, and gave encouragement for further experimentation.

THE use of titanium as an alloying element for steel is shrouded in secrecy. According to information supplied to the United States Bureau of Mines, carbon-free ferro-titanium has been employed in Europe for making an electric steel containing 5 to 7 per cent. titanium. Rumours of the use of titanium-alloy steels for armour plate have been circulated, but so far as is known, no merit has been found in the addition of titanium to steel as an alloying element, and experiments with steels containing 0.1 to 1.0 per cent. titanium have shown no special advantages. A more interpretative investigation than any so far carried out, is required to distinguish clearly the merits of titanium-alloy steels, and it must be assumed now, pending exact proof to the contrary, that these steels are of no particular value, or at least yield no advantages not provided by other steels. It is rather difficult to get the carbon-free ferro-titanium to alloy with steel without much loss of titanium, and this fact, coupled with the high price of the carbon-free alloy has tended to discourage experimentation by steel makers in this direction. It is possible, however, that if the cost were less, some combination of titanium, either alone or with other metals, might produce valuable steels for some purposes. Titanium increases the hardness of steel, and experiments on titanium steels have been made by Guillet, Braun, and Lamort. It has been shown recently in Bulletin 199 of the Bureau of Mines that fair recoveries may be expected with carbon-free ferro-titanium, provided the alloy is added at the end of the heat, and the steel is very hot.

Miscellanea.

IT is announced that owing to the stoppage of coke deliveries from Germany, ten blast furnaces have shut down in Lorraine, three in the Longwy-Nancy Basin, and five in Luxembourg.

THE various French companies associated with the Standard Oil, the Anglo-Persian, and the Royal Dutch companies are establishing important stations at Dunkirk for the supply of oil fuels to the industrial centres of Northern France.

A SCHEME to prepare and issue a list of all scientific periodicals containing the results of original research, with an indication of the chief libraries in Great Britain where they may be consulted, has been drawn up by the Conjoint Board of Scientific Societies.

MORE than half the space available for electrical engineering exhibits at the British Empire Exhibition has been booked already. In this section, with an area of 200,000 square feet, organised by the British Electrical and Allied Manufacturers' Association, there will be a mile of gangways, and nearly 2 miles of stand frontages.

DIRECT radio communication has just been set up between France and Poland. Since December 5th direct communication has been established between stations at Paris and Beyrout, served respectively by the Radio France and Radio-Orient companies. Urgent telegrams are received at triple tax, and deferred and Press telegrams at half tariff.

GERMAN competition is forcing Japanese cement out of Far Eastern markets. Japan is still shipping 50,000 tons a month to Shanghai and Manila, but Germany has been able to undersell in the Straits Settlements, and Singapore recently placed an order for 40,000 barrels of German cement. The large export cement business to Euzope which Japan built up during the war has now disappeared altogether.

THE Niagara River Bridge Company and the Michigan Central Railroad Company will construct a new steel arch bridge over the Niagara River, near the falls, to take the place of the present cantilever bridge. It will have a span of 640ft. and a double rail-track. The contract has been given to the American Bridge Company, of Philadelphia, and the cost is estimated at approximately 2,000,000 dollars.

IT is reported that the Advisory Committee for Public Works of the Corporation of Amsterdam has decided to advise the Municipality to construct a tunnel for traffic under the Y, the river communicating with the North Sea Canal from Amsterdam to Ymuiden. It is estimated that the cost of this tunnel will be 10 to 11 million florins. Difficulties in the way of constructing the tunnel are:—(1) The extremely soft subsoil; and (2) the construction of approaches in a suitable part of Amsterdam, the peculiarity of the town being its concentration between the principal square and the station. It is understood that with a view to the greater prevalence of motor traction, these approaches will not be required to be so long as was first intended, a slope of 1 in 20 being considered quite practicable.

IT is officially announced that the Union Steel Corporation of South Africa, Limited, and the South African Iron and Steel Company intend to form themselves into one large concern. The new company, if financial negotiations are successfully concluded, will be supported by very large and important financial houses and steel producers in England. Under the proposed agreement, the works of the Union Steel Corporation at Vereeniging will be extended for the production of galvanised and black sheet iron and wire of all descriptions and sizes, of nails, bolts, nuts and articles of like nature. The existing steel foundry will be enlarged to produce every possible type of steel casting, and in conjunction with it it is proposed to erect the necessary machine shops. Blast furnaces for the production of pig iron and mills for the rolling of heavy sections will be erected at Pretoria.

THE British Cast Iron Research Association reports that arrangements for definite research outlined in the December circular have been completed by the appointment of two research assistants working at the University of Birmingham and the University of Sheffield. The director will be in constant touch with these two centres of active research, and this side will be supplemented by visits to the co-operating foundries working on the scheme. Extensive work of this nature will naturally occupy considerable time, but it is hoped that the co-operative scheme will enable the Association to issue results to its members in progressive stages. The Association has under consideration the final B.E.S.A. specification for malleable iron castings for automobiles which has been prepared in co-operation with the Malleable Casting Committee of this Association. The Research Committee has appointed as research assistants Mr. E. C. Dickinson, B.Met. (Lincoln), who will work at the Sheffield University, and Mr. H. J. Simcox B.Sc. (West Bromwich), to work at the Birmingham University.

THOSE interested in the increasing use of central heating in this country were given information which would lead to economy in working and also in fuel by Mr. B. R. Wingfield at a meeting of the Institution of Heating and Ventilating Engineers on January 12th. After describing various types of regulators, he remarked that he was convinced that overheating would be avoided, and that there would be a saving in fuel, to the ultimate benefit of the community, if temperature regulation was made a regular part of every central heating installation, whether large or small. Increased numbers of installations would bring down first costs and the reputation of central heating of being a costly and therefore a luxurious method of warming, which only the wealthy could afford, would disappear. The question of reliably regulated and simple central heating was very important at the present time, when on account of the difficulty of getting domestic help, the question of the "labour-saving house" was a subject of frequent discussion. There was no reason why a carefully planned hot-water heating installation should materially add to the cost of, say, a five or six-roomed house, if the saving in chimneys and fire-places was taken into account.

THE DUTCH DIESEL-ELECTRIC DEPOT SHIP PELIKAAN

(*For description see page 110*)

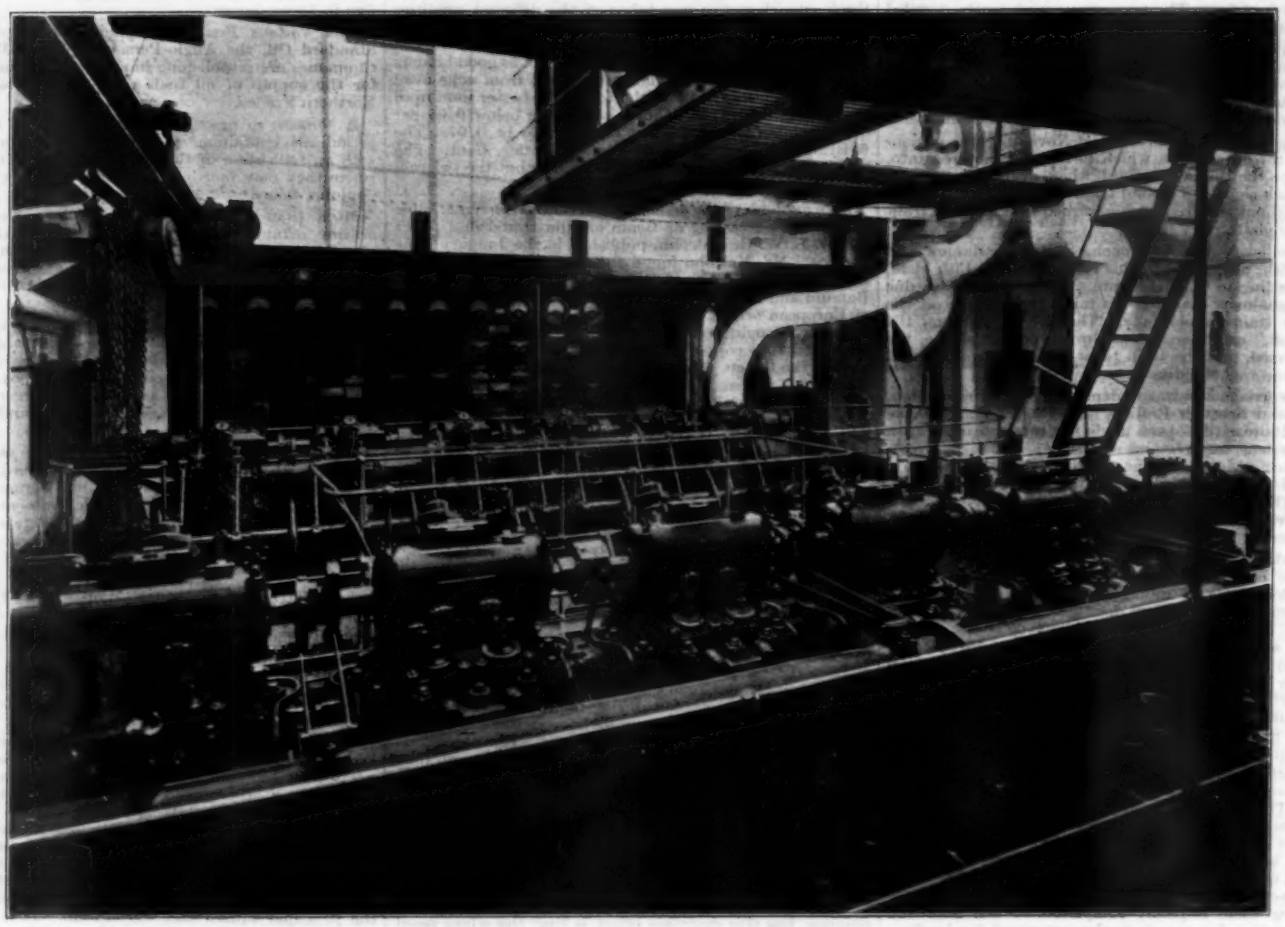

FIG. 4—MAIN ENGINES AND SWITCHBOARD

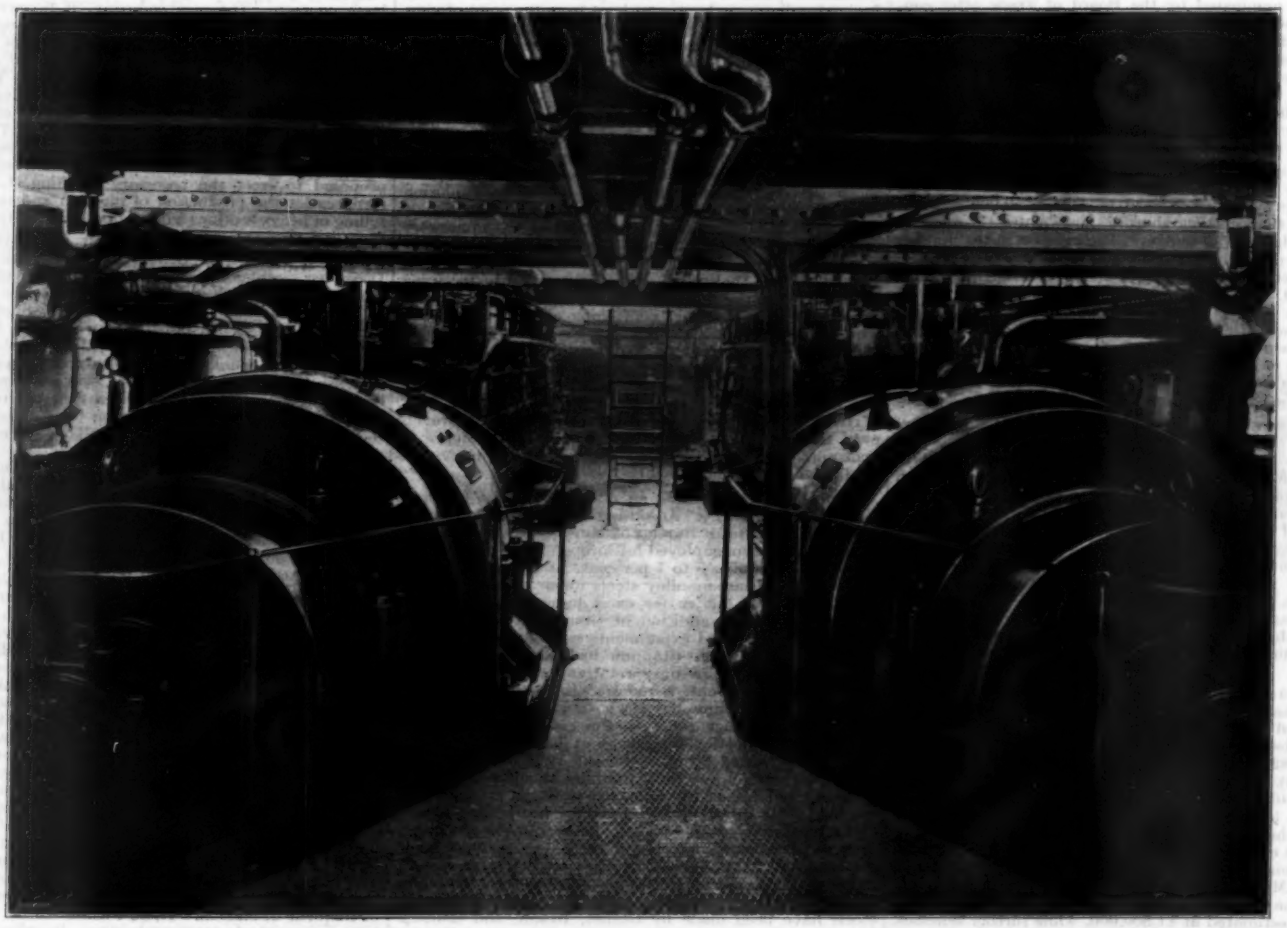

FIG. 5—ENGINE ROOM, LOOKING FORWARD

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THE ENGINEER.

FEBRUARY 2, 1923.

Main Line Railway Electrification.

WHILE railway electrification in the United Kingdom is in very much the same position as it was before the war, other countries have made, and are still makng, material progress. On the Continent of Europe there are about 3240 miles of main line working with electric locomotives, whilst in the United States there are 2030 miles. Although much consideration has been given to the matter in Great Britain, the work that has so far been undertaken is confined to suburban lines, operated mainly with motor coaches. The electrification of the North-Eastern lines between York and Manchester and those of the Brighton Company between London and Brighton, has formed the subject of many discussions, but no steps have as yet been taken to put the work in hand. Financial considerations and the inability to decide whether main-line railway electrification is desirable or not are probably the two principal reasons why the electrification of British systems does not materialise. The question of the proper scheme to adopt may possibly have some bearing on the matter, for although it has been proposed to employ a standard direct-current pressure of 1500 volts, there are, of course, engineers who disagree with that policy. In the meantime, however, progress is being made in other parts, and not only in those where water power is available. The scarcity of coal is, it is true, largely responsible for the electrification of the Swiss, Bavarian and Austrian State railways, but it is not difficult to point to examples of main-line electrification which have no connection with water power. Whilst hydro-electric stations provide the power for the above-named schemes, and also for the Italian railways, brown and black coal will be utilised for the supply of power to the Prussian and Silesian lines, and in the case of the Czecho-Slovakian railways, both coal and hydraulic power stations will provide the current.

It has been argued by a prominent English electrical engineer that single-phase working is only really applicable where low-speed water turbines can be used, but it is, of course, well known to all familiar with the subject that there are plenty of single-phase lines which are supplied from steam stations. While sixteen-cycle current, which can be conveniently generated by water power units, is the best periodicity for single-phase traction, twenty-five-cycle current can also be employed. The Brighton electrified lines which have been in successful operation for twelve years, are worked with single-phase current at this periodicity, and a considerable mileage of single-phase 25-cycle track exists in America. The chief obstacle to the adoption of the alternating-current system on main lines now appears to be the desire to supply all current for industrial and traction purposes from large fifty-cycle stations. In the past there were other objections, which, however, seem to have been forgotten, and the principal argument against the scheme in these days is that as single-phase traction motors will not work with fifty-cycle current, the railways would have to be allowed to erect power stations of their own. Unless some method is found which will enable fifty-cycle current to be supplied to trains, or the idea of supplying all railways from the fifty-cycle systems is abandoned, direct current must be resorted to. It is said, however, that in Germany a scheme which is being tested enables fifty-cycle single-phase current to be used for the operation of trains. No one imagines that railway electrification has reached the stage of finality. In a few years' time new ideas may lead to different methods being adopted, and to main-line electrification in this country being viewed in a better light. Simplicity and efficiency are the two most important features in connection with extensive electrification schemes. However much engineers may be inclined to favour direct current, there is no getting away from the fact that it introduces complication between the generating station and the track. None save those who are unfamiliar with the trend of electrical development can fail to see that the practice of changing from alternating current to direct current by means of rotating machinery will sooner or later be abolished. If it is always considered desirable to work all trains with direct current, the conversion will eventually be done with rectifiers, although not necessarily of the kind now in use. The power rectifiers that have been introduced within recent years have not, of course, been favourably received by makers of converting machinery, and although perhaps some of the adverse criticism is justified, there does not seem to be much doubt that large, efficient and relatively cheap rectifiers will eventually be produced.

All the complications that have been introduced with the idea of making sub-stations automatic in action, so as to save labour, will, unless we are very much mistaken, ultimately give place to something infinitely more simple and less costly. Nevertheless, it does not follow even if the conversion of alternating current into direct current is reduced to the simplest process imaginable, that direct current will always be the most suitable kind of current for the propulsion of trains, for it is to be remembered that a current which is continually changing its direction enables the pressure to be changed with static transformers. Thus single-phase trains can collect their current at a pressure of 15,000 volts or more, whilst the motors can work at any desired pressure, and speed control becomes possible without the use of rheostats. Perhaps, after all, it is just as well that main-line electrification in this country is in a backward state, for it is possible that before long electrical engineers will find a better solutiof to the problem than any so far put forward.

The Accuracy of Gear Wheels.

IT is a remarkable fact that, although toothed gearing has been employed for one purpose and another for many hundreds of years, it still presents problems for the geometrician and the engineer. Even so simple a matter as the best form of tooth for a specified purpose, a matter which one would have imagined could be settled offhand by experiment, is still undecided, whilst the proportions of the teeth are even to-day fixed rather by individual selection than by reference to an invariable standard. For a time cycloidal teeth were favoured, but by degrees the involute tooth, on account of the ease with which it can be produced and the liberty it allows in final adjustment, replaced it for nearly all purposes. Then the stub form of tooth—an involute tooth with nothing but the middle portion left—came largely into use. Now the stub is falling somewhat into disrepute, and even the superiority of the involute tooth is challenged. Moreover, in the search for quietness and smoothness of operation the helical tooth has advanced rapidly into favour and is employed not only for the biggest work, as in the reducing gear of turbine-driven ships, but in such small work as may be found in motor cars. As in all engineering developments, the reasons for the changes resides as much in collateral progress as in the things themselves. For example, the popularity of the involute tooth must, in no small degree, be attributed to the ease with which it can be generated by reciprocating tools or by hobs, and the introduction of the stub tooth arose partly from deficiencies in material

and partly from deficiencies in gear cutting. Will the improvement of material, combined with the high refinement that is now possible in the production of teeth, lead to the return of the full-length tooth? Again, the rise into prominence of the helical tooth is due more largely to the fact that it runs sweetly and noiselessly than to any other cause, and it may disappear again when straight teeth have the same qualities.

Of all recent developments in the production of gear wheels, the employment of heat-treated and hardened steel which is brought to its correct form by grinding is the most interesting and the most promising. Grinding may be carried out in two ways. We may either employ a grinding disc shaped at its periphery to tooth outline, or a flat cutting face, which, in a well-known manner, may be made to generate an involute tooth. Between the merits of the two methods we do not propose to judge, but rather to record a few observations on the nature of the problems involved and of the methods employed, as they were revealed to us in a conversation recently with Mr. H. F. L. Orcutt at the works of the Gear Grinding Company, of Handsworth. This company employs "formed" discs; that is to say, the edge or periphery of the disc is made to the shape of the space between two teeth. The accuracy of the product depends upon the accuracy of the disc, and that is maintained through frequent correction by means of diamonds whose motion is controlled by "formers." For a complete description of the machine we refer our readers to THE ENGINEER of July 29th, 1921. Now there are several remarkable facts about gears produced with the high degree of accuracy attainable by this method—a degree of accuracy which is within the limit of three ten-thousandths of an inch. In the first place, we must note the silence with which a pair of gears so produced will run together. If we take the best possible pair of uncorrected gears and make one drive the other at high speed—say, for small pairs, 3000 revolutions or so—we shall inevitably get a good deal of noise. But if we take two ground gears and test them under precisely similar conditions, they will revolve practically noiselessly. From this comparative test it is obvious that noise is produced by extremely small errors of form, and that it is not an inherent and inevitable characteristic of toothed wheels. But we may go even a step further. Great as is the degree of accuracy attained by grinding, there is still a small error, so small that it is practically immeasurable, and yet reveals itself by the noise test. It has been found that to obtain the greatest degree of silence a monogamous marriage of the pairs is essential. If we take the "male" of one pair and mate it with the "female" of another pair, it is improbable that they will run with equal silence. From this fact we may conclude safely that errors within the three ten-thousandths limit are sufficient to cause noise. That is a very remarkable fact, showing that when we are dealing with geometrical forms—as the teeth of wheels are—the slightest—the unthinkably slight—departure from truth has a striking effect. A still more remarkable fact is that the human touch can, in appropriate circumstances, distinguish these infinitesimal difference. If two wheels do not run silently together they are placed in gear upon two pins and a skilled examiner works them together and "feels for" the defect. Mr. Orcutt informed us that experienced men could tell by touch just at what point on the teeth there was an error of form, and when that error was removed—which may easily be done by a slight change of the "formers" which control the diamonds—the noise disappears. Is it not an astonishing thing that so slight a defect, a defect less in dimensions than one-third the thickness of a thin cigarette paper, should be discoverable by unaided human touch! The whole process is a revelation in accuracy, and we shall be surprised indeed if, now that the need and the advantages of grinding have been demonstrated, tooth grinding does not become the standard practice for high-speed gears.

The results already attained by Mr. Orcutt lead the mind to further considerations. Beginning with relatively small wheels, the gear wheels of motor cars, which still occupy nearly all the attention of the firm, a start has been made on much larger pairs, as, for example, the pinions and wheels for electric railway coaches and for gears capable of transmitting hundreds of horse-power at high speed. Here we see the beginnings of an important development. A large portion of the noise produced by electric trains and tramcars emanates from the gearing, and it may be reduced to negligible proportions by grinding the teeth to true form. But we may go a step further. The efficiency of gears that are well-nigh perfect must be very high. In place of the two-speed reduction gears now employed on turbine steamers, could we not use a three-speed reduction gear with straight in place of helical teeth and with no increase of noise or decrease of overall efficiency? Or, alternatively, may we not venture to hope that the ability which has produced a machine for grinding straight teeth will produce one for grinding helical teeth, and that we shall be able to employ heat-treated and hardened steel pinions and wheels for turbine reducing gear? It is impossible to believe, now that we know the importance of almost absolute accuracy and have the means of attaining it, that the development of those means will be reserved for small units and small powers.

Girder Bridge Design.

By T. C. HOOD, B.Sc.

MODERN ideas as to what constitutes good design in a steel structure are the results of a progressive development in the minds of designers during the past century. The earliest designers were men in whom the faculty which we may call engineering instinct was highly developed, but who, as a rule, had no knowledge of the mathematical principles which determined the stresses in the various parts of the structures they built. The fact that they were able to build bridges of considerable magnitude which gave satisfactory service for many years must always be a source of admiration and wonder to succeeding generations. The discovery of the laws governing the distribution of stress in beams and articulated structures followed the work of these engineers, and gradually, as this knowledge was developed and spread abroad, gave lesser men the power of design.

With the introduction of cheap rolled iron sections the demand for designs for structures of all kinds grew rapidly. This stimulated the study of design, produced new designers and rapidly developed the art of design. In the last thirty years particularly strong influences in the development of design have been the publication of many excellent text-books on stress distribution and the employment of designers by manufacturing firms. Ambitious young draughtsmen, trained in the works, knowing all the details and processes of manufacture and the possibilities of tools and workmen, found evening classes at which they could acquire education in technical subjects, and well-written text-books, which gave them the theoretical knowledge they required. In their daily work they had opportunities of studying designs by many professional engineers, and as they took out quantities and prepared estimates for the work, comparison between one design and another was inevitable. A few years at this work converted a keen draughtsman into a capable designer, and an asset of the utmost value to his firm.

The manufacturer found himself in a position to offer suggestions to an engineer for the modification of his design, and, as confidence in his staff grew, was able to offer complete alternative designs with advantage in cost to the purchaser. And so has grown the modern practice of tendering for manufacture with design. Consulting engineers have acquiesced in this arrangement, because it simplified their own staff problems and gave them the advantage of expert assistance, while leaving the final approval of design in their own hands.

Manufacturers improved their designing staffs and began to be regarded as experts in design as well as in fabrication, and were often approached by purchasers without the intermediary consulting engineer. That the quality of their designs should have improved steadily until it reached its present very high level of excellence, instead of being degraded by subordination to the natural desire for high profits, is very much to the credit of manufacturers in general. The tendency of design through this period has been towards simplicity and, by the correct placing of adequate material, lightness. The combination has resulted in reduction in cost, and improved efficiency.

It is curious that the modern development of design should apparently have been effected by the consulting engineer, the professor and the manufacturer. The person most directly and personally interested—that is to say, the maintenance engineer—does not appear to have had any say in the matter. This omission may be more apparent than real, but it is certainly the case that, as far as railway bridges are concerned, improvements in design with the object of increasing their expectation of life are far less evident than improvements for efficiency and low first cost.

THE CALCULATION OF STRESSES.

Modern English practice in the computation of bridge stresses is so nearly standardised that the variations in detail adopted in different offices have hardly any effect on the sizes of the members of the structure. The publication by the British Engineering Standards Association of a standard specification governing stresses and methods of calculation, as well as manufacture, will no doubt reduce the present variations in practice to a minimum.

Among many bridge engineers, however, there is a growing doubt as to the accuracy of the modern method of stress calculation. The use of the Fereday-Palmer stress recorder, an instrument whose accuracy is unquestioned, shows in many cases that the actual stress in a bridge member is quite different from the calculated stress. The calculation of stress in old bridges frequently indicates stresses whose magnitude is denied by the physical condition and behaviour of the bridge.

In plate girders there is not much question as to the correctness of the moment of inertia method of calculating flange stress, but there is considerable doubt about the stresses in the web and web-to-flange rivets. Very high bearing stresses between the web plate and rivets connecting it to the flange angles, as calculated by the most accurate methods, may possibly exist without showing any sign of their existence, because the flow of the overstressed metal is resisted by the comparatively lightly stressed metal held firmly round it by the strong grip of the rivet heads. It is difficult to devise any experimental method of discovering the truth in this matter.

In trussed girders there is room for more comprehensive doubt. The ordinary calculations for primary stress in a truss depend for their accuracy upon a number of assumptions which are entirely unjustified in fact. Excentric connections, unsymmetrical members and rivet groups have practically no place in modern bridge design, so that secondary stresses produced by such irregularities may be left out of our consideration. But the secondary stresses produced by the distortion of a truss under load must always be of serious magnitude. The text-books give details of the long and laborious calculations necessary to arrive at an estimate of the magnitude of these stresses and also of the method of computing the small deduction to be made from the primary stresses before the secondary stresses are added to them to give a correct grand total. It would appear that in trusses of ordinary proportions secondary stress due to truss distortion amounts to from 10 per cent. to 120 per cent. of the primary stress. It will naturally be greater in a shallow truss than in a deeper one of the same span, and for any given span and deflection it will be greater in the truss which has the broader and deeper members and the larger gusset plates at their connections.

While it is difficult to discover any flaw in the reasoning of the text-books, it is equally difficult for the bridge engineer who has had much experience with old bridges to reconcile the two. There must be many bridges carrying their load with every evidence of safety, in whose members and joints the orthodox calculations will discover stresses exceeding the ultimate strength of the material.

The common basis of all specifications regulating design may fairly be described as a conviction that in no part of the structure must any probable combination of loads produce a stress exceeding the elastic limit of the material. It will seldom be questioned that a structure which is stressed in any part beyond the elastic limit of the material must, after a certain number of repetitions, disclose the fact by its altered shape. If the converse of this be true, that a structure which retains its original shape has not frequently been stressed in any part beyond the elastic limit of its material, then the orthodox method of calculation must be defective.

For the designer of new bridges this is not of great importance, because his experience assures him that his methods produce bridges which give satisfactory service at reasonable cost. But the railway bridge engineer is in a very different position. He is expected to decide as to whether a bridge may safely be allowed to carry heavier engines than those at present in use, or whether it is safe to allow it to continue to carry its accustomed loads, whether a speed restriction will enable it to carry on safely, or a reduction of load is necessary. These are decisions which frequently involve very large sums of money, saved to the administration by the introduction of heavier engines and loads, or lost in increased cost of transportation by reduction of loads and speeds. The engineer will give his decision after careful inspection of the bridge and precise calculation of existing and altered stresses. If the results of his inspection and calculations confirm one another, the outcome is clearly indicated. But in many cases inspection and calculation reveal entirely different conditions and the bridge engineer is compelled to revert to his engineering instinct, or, more easily, play for safety at the expense of the administration.

The desirability, in the interests of bridge owners as well as in those of the engineering profession, of discovering the meaning of these discrepancies between theory and practice is quite obvious. If bridge owners, Government departments, and professional societies can be induced to view the matter as one worth spending money on, there is no doubt that mathematicians and bridge engineers can be found in many quarters to carry out the necessary investigations.

The tests of bridges, with stress recorders and deflectometers, which have recently been made on a large scale in India under the authority of the Indian Railway Board, and in England by the Ministry of Transport and British Engineering Standards Association, although primarily intended to decide the vexed question of impact, may possibly help to throw

light in other directions. If all efforts to discover the truth about bridge stresses could be co-ordinated under a single authority a great deal of time, labour and expense could be saved, and decisions could be accepted with the greatest possible confidence.

IMPACT STRESSES.

Regarding impact as the difference between the effect of a static load applied so gently as to produce no vibration in any part of the structure, and the effect of the same load when rolled at speed over the bridge, it is clear that we divide all the stresses into two classes, viz.:—

(*a*) Those due to loads, assuming them to be static.
(*b*) Those due to impact.

The algebraic sum of the two classes of stress should give, for any member, the actual stress as measured by a stress recorder. In the past, divergence between calculated and measured stress has been attributed to defects in the measuring instrument and error in the method of calculating impact. But the author is not aware that any serious attempt has been made to confirm by experiment the recognised methods of calculating static stress, although that would appear to be the natural first step in the process of investigation.

The difficulties in the way of determining static stress by measurement are considerable. Owing to the existence of secondary stress due to truss distortion, the static stress in a member may not be uniform in any cross or longitudinal section. Extensometers and stress recorders give the average stress over a length of from 20in. upwards, and are therefore quite useless for the purpose of measuring the actual stress at a particular point. But it should not be impossible to devise an instrument capable of measuring a difference in stress of one-tenth ton per square inch on a length of 1in. It need not be a recording instrument for static stress, and instrument vibrations would be allowed to die out before taking a reading. Such an instrument would enable us to make a complete survey of the increase in stress in different parts of a member simultaneously, for a definite added static load. This line of investigation should enable us to decide whether the presence of heavy deformation stresses involves a great reduction in primary stresses, or whether the accepted theory is correct. There are a great many other questions concerning the magnitude of local stresses due to a variety of causes which the instrument might be used to elucidate for the benefit of the railway bridge engineer.

The subject of impact has been discussed widely for a number of years, and many experiments have been made with the object of discovering by how much the static stress, as calculated, should be increased to cover all the effects of the moving load. The only definite conclusion arrived at up to now and generally accepted is that very many more experiments must be made before the investigation can be called complete and satisfactory deductions drawn.

A comparison between the records, whether of stress or deflection, made during the passage of a train over a span at speed and dead slow, will at once lead to the conclusion that impact stress is a vibrational stress. The record at dead slow is a smooth curve indicating gradual variation in stress or deflection. The record at speed is a jagged curve composed of a series of rapidly alternating peaks and valleys whose mean line—reduced to the same time scale—corresponds with the "dead slow" curve. The increment in stress or deflection which is due to impact is represented by the height of the peak above the mean line at any point. Now, the vibrations of an elastic body reach a maximum amplitude when the periodicity of the impulses causing vibration coincides with the periodicity of the vibrating body. One would therefore expect to find some regular variation in the record to correspond with a regular variation in the speed of the train. This effect is generally discoverable in the records, but is not by any means regular. The periodicity of vibration of any member varies with the stress in it, and its vibration must be complicated by the vibration of other parts of the structure, all under constantly changing stress. The vibration of a truss, as a whole, varies irregularly as the load moves over. The impulses which produce the vibration in the bridge are not simple, but exceedingly complex. It is probable that the revolving unbalanced masses in the engine driving wheels provide the most important series of impulses, but there are many sources of vibration which interfere and make it difficult to link up a particular effect to its own particular cause, and even when that can be done it is by no means safe to say that the occasional omission of a particular cause will not result in an entirely different manifestation of effects from other causes. For example, the vibrations produced in a 200ft. truss by the driving axles of an engine will not reach their maximum amplitude until they have been established for some few seconds at least. Assuming that the engine is travelling alone and that its speed is such that the periodicity of its impulses agrees closely with that of the truss as loaded, the amplitude of the truss vibrations will rapidly reach a high value. If, on the other hand, the engine, travelling at the same speed, is followed by a series of train axles irregularly spaced and loaded, these following loads will have the effect of damping out a great deal of the engine effect before it has become clearly evident in the record, so that the impact effect recorded is much less than before, and there is no obvious indication as to what might be expected if the train were omitted.

It is clear that the experiments which must be made for the satisfactory elucidation of the subject of impact may conveniently be divided into two classes. First, a series of experiments on a selected span to show the effects of variation in speed of load, design of engine, composition of load, position of rail joints, condition of track and wheels. Second, the same series of experiments on a variety of bridges to show the effects of variation in type of bridge, span length, relative weight of span and train, relative weight of trusses and floor system, bridge camber and deflection. Other points will no doubt suggest themselves to bridge engineers as worthy of consideration, but those mentioned are sufficient to provide material for many thousands of stress and deflection records. It will be quite clear that the elucidation of the subject involves an immense amount of work and a great deal of expense.

When this work has been done the engineering profession will have definite facts at its disposal in the place of personal opinions. These facts should enable the designer to proportion his structures in the most economical way with greatly increased confidence.

It will be realised that the idea behind this disquisition is that the future development of design is in the hands of the bridge owner and his bridge engineer, rather than in those of the consulting engineer, the professor and the manufacturer. And when the owner's efforts have resulted in an altered specification which reduces the first cost of his bridges, he may be inclined to turn his attention towards the problem of increasing their average length of life. There is no very obvious reason why a steel bridge should be allowed to corrode unhindered for forty years and then be scrapped. The cure probably lies in modification of details of design of steel work and its supports, and in improved maintenance organisation.

Iron and Steel Outlook.

AT the fourth annual dinner of the London Iron and Steel Exchange at the Trocadero Restaurant, London, on Tuesday, January 30th, Sir William J. Larke, K.B.E., made an important speech on the possible effect upon the British iron and steel trade of the French occupation of the Ruhr, and spoke in terms of doubt of the after results, say, in 1924 and 1925. Up to the time of the French action in the Ruhr, he said, conditions in Great Britain had reached what might be called stability as regarded prices. The cost of living figures had only varied eight points throughout 1922. Moreover, in that year, Great Britain headed the list of iron and steel exporting countries. That position had only been brought about by what he called heroic efforts on the part of both employers and employed. Manufacturers had sold, during 1922, at prices well below production costs in order to maintain employment and keep their works going, and had only got back some proportion of their standing charges. All that, however, had been changed by the adventure of France into the Ruhr, but for which we might have hoped for steady upward progress during 1923. It might be anticipated, as the result of the step France had taken, that neither she nor Germany would be an effective factor in the export trade for several months, at least. We knew that America had such an intense domestic demand—in 1922 her exports were only 7 per cent. of her total output—and there was so much reason to believe that that demand would continue, that she would not be an outstanding factor in the export trade. All these things meant—and he wished to emphasise the point—that the iron and steel trade of Great Britain would receive a stimulus and be able to recover from its customers its full standing charges and a little bit of profit. That meant that prices must advance, but he sincerely hoped we should have nothing like a boom, because a boom brought its inevitable reaction. We had a boom in 1920, we suffered for it in 1921, and paid for it in 1922, and we did not want that experience again. However, he felt that 1923 was all right, but what about 1924 and 1925 and thereafter? With regard to them he had a little misgiving, and although he might be wrong, he would like to state briefly the position as he saw it.

All the continental producing countries had increased their productive capacity. Belgium had a capacity of 3 million tons per annum, and must export 66 per cent. to keep her works employed. Luxemburg had an output of 2 million tons, and must export 95 per cent. to keep her works going, and she did so in 1922. France—admittedly out of the picture for 1923—had a domestic consumption of only 3 million tons, whereas with Lorraine she had a productive capacity equal to that of Great Britain; in fact, under the new arrangement with Lorraine it was possible she would take second place to the United States; with an output of 12 million tons per annum or thereabouts, she would have to export 66 per cent. of her output. It was difficult to say what the domestic consumption of Germany would be in 1924 and 1925, but the fact that in 1922 the estimate of Germany's production was 8 million tons, of which 7½ million tons were consumed within her own borders, indicated that there had been a very great extension industrially as well as otherwise. Those figures must mean that Germany had enormously increased her productive capacity during the last year. No doubt largely due to the flight of the mark, everybody in Germany was getting rid of their money as fast as they got it. The workmen were spending theirs, and the industrial people either sent it out of the country or converted it into real property. That practice accounted for the fact that during a recent visit to Germany he saw great developments being undertaken in the way of the erection of new furnaces and works extensions generally. Money seemed to be spent like water, and the result was that it was impossible to forecast the potential value of Germany's competition. We could, forecast, however, that Germany would have a large exportable surplus as soon as the conditions were such that she could resume her ordinary trade.

Each one of the countries he had mentioned had taken some steps towards the organisation of its iron and steel industries on a national basis, particularly with regard to the development of foreign trade. In Belgium, the Government had guaranteed a loan for 250 million francs, whereby Belgian Nationals are guaranteed the payment of their accounts on export trade, to a certain extent, provided the Government does not lose on exchange. The Belgian Government had also guaranteed, within the past two or three weeks, the accounts of Belgian Nationals engaged in carrying out foreign contracts, and the Belgian iron and steel trade had been striving for some time to get together and arrange an export policy. The French iron and steel masters, with six of the principal banks in Paris, had been conferring for a long time concerning a very broad programme for the development of the export trade, whilst the Germans, as was well known, were well organised before the war. The Stahlswerk Verband, we had been told, had been dissolved and was not to be resuscitated, but the fact was that there was no need to resuscitate it. The German iron and steel industry was controlled by three men, Stinnes, Thyssen, and Woolf, but the German trade would not be conducted on an individualistic basis in future. As a matter of fact, we in this country had ascertained that these three men were spending considerable sums on an organisation which they had set up to investigate the question of fuel economy. They had been driven to use lignite and various fuels of low calorific value in metallurgical processes in a manner that had never been done before, and all that must increase Germany's ultimate capacity as a competitor.

What were we going to do? He wished to put in a personal plea because the position caused him considerable anxiety. He believed that the competition of the future was going to be more severe, more scientific, and more concentrated than the industry had ever experienced before, and he hoped we in this country were going to conduct our industry on a national basis in future. He did not think it possible that a strictly individualistic policy—which he knew was the strength of our national character—could really meet competition organised on a national basis by our foreign competitors, such as he had outlined as likely to be the outcome of war conditions.

THE DIESEL ENGINE USERS' ASSOCIATION.

IN our issues of October 27th and November 3rd we dealt with Mr. Geo. E. Windeler's paper on "The Care and Maintenance of Diesel Engines." The Association has now issued the paper, along with a full report of the discussion, and we can recommend this publication to all interested in the management and the operation of heavy oil engines, whether for land or marine work. In summarising the paper and the discussion which followed, Mr. C. O. Milton, the President of the Association, referred to its very practical character, and said that the points raised were mainly such as should be noted and applied rather than differed from or critisised. At the same time matters which at first sight had seemed somewhat ordinary in themselves had received a great deal of attention, and progress had been made. The subject of fostering a real spirit of co-operation and team work in engine-room staffs, which is essential to the successful working of a large oil engine plant, had, Mr. Milton said, been largely absent from previous discussions. Mr. Windeler's wise remarks were clearly much more valuable than notes about rules, instruction warnings, and modes of checking what has been somewhat disparagingly alluded to as "the human element." The amount of attention this subject received showed that there was a consciousness that there has been in the past a tendency to undervalue the importance of the work of the running staff, who are responsible for the safety and good performance of the engines during probably 90 per cent. of their service. Economy in consumption of fuel and lubricating oil, reliability and life of working parts, are all materially affected by the degree of judgment and skill of the men running the engines. These qualities can only be acquired through interest and understanding, and are best developed by instruction, explanation, and encouragement of effort. The keenness and co-operative spirit of a staff is increased by keeping it well informed as to the working costs obtained, improvement effected, or any falling away from previous standards, and the staff should be interested in any investigation of troubles met with, or new improvements adopted.

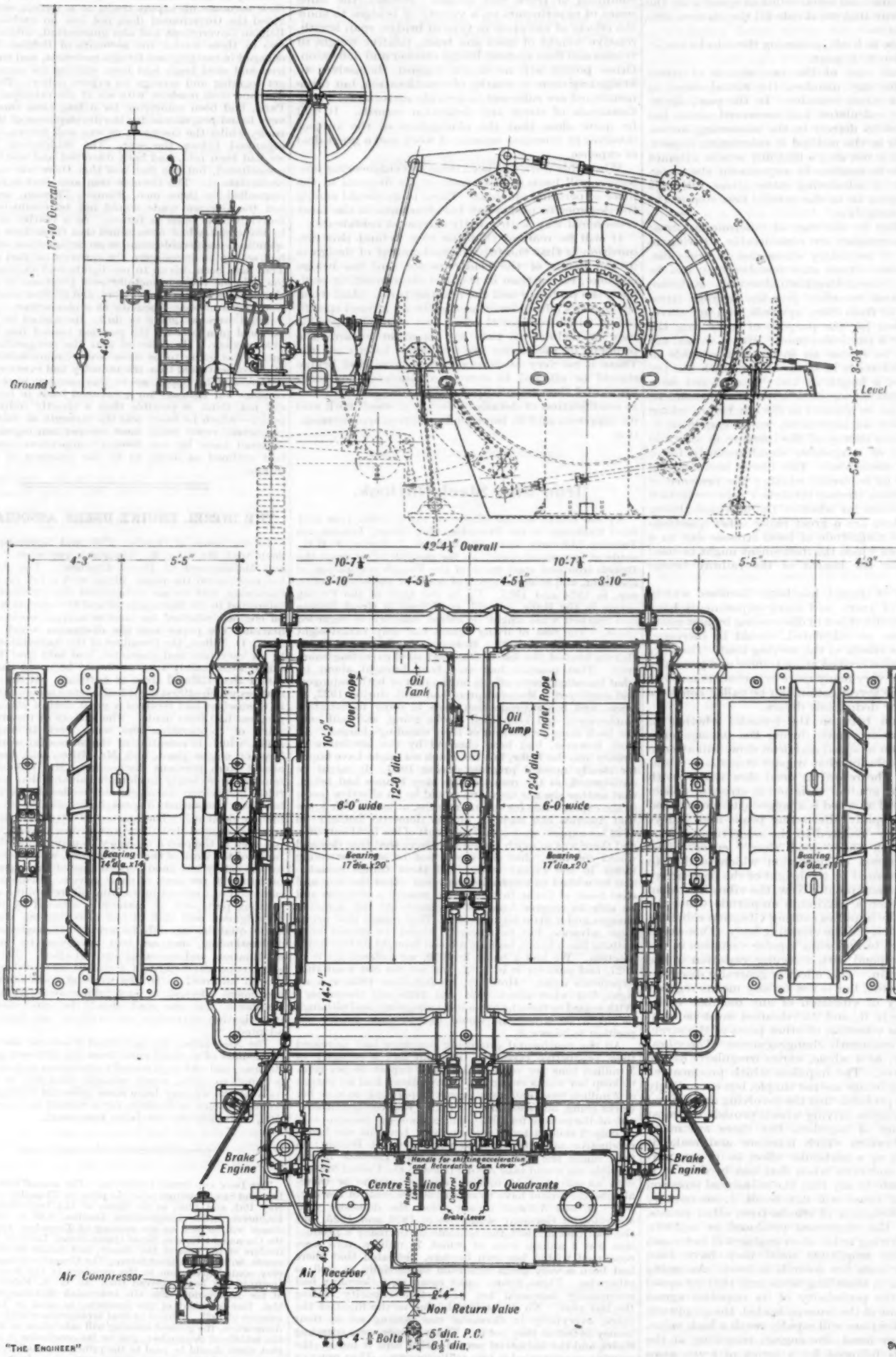
The Association has instituted a scheme for collecting particulars of working costs from the different generating stations, and although friendly emulation and competition is bound to ensue, much valuable data will be obtained. As a nation we may have some grievous failings, but we do get up some enthusiasm for a contest in judgment and skill, especially one involving team work.

THE IRON AND STEEL INSTITUTE.—The annual meeting of the Iron and Steel Institute will take place on Thursday and Friday, May 10th and 11th, at the home of the Institution of Civil Engineers, Great George-street, London, S.W. 1. The annual dinner will be held on the evening of Thursday, May 10th, at the Connaught Rooms, Great Queen-street, London, W.C. Particulars of the cost of the dinner, and details of the arrangements, will be circulated later. The Council announces that a very cordial invitation to the members of the Iron and Steel Institute has been received from Mr. G. E. Falck, President of the Associazione Fra Gli Industriali Metallurgici Italiani, hon. Vice-president of the Institute, to meet in Italy in the autumn of 1923. Subject to final arrangements with the Italian Association, the general meeting will take place at Milan about the middle of September, and on its conclusion it is proposed that visits should be paid to the principal metallurgical centres and to the hydro-electric power stations in Italy. The tour will also include visits to Rome, Naples, Genoa and Turin, and is expected to occupy altogether about nineteen to twenty days from the time of leaving London until the return.

ELECTRIC WINDING PLANT FOR THE RANDFONTEIN MINES

FULLERTON, HODGART AND BARCLAY, LIMITED, PAISLEY, ENGINEERS

(For description see opposite page)



"THE ENGINEER" SWAIN Sc.

The Largest Electrical Winding Plant.

THE two new winding machines which have just been put to work at the north vertical shaft of the Randfontein gold mines, South Africa, and which are illustrated by the drawings reproduced on the opposite page, are said to be the largest of their kind so far constructed.

These winders, built by Fullerton, Hodgart and Barclay, Limited, of Paisley, have been installed with the object of increasing the capacity of the mines plant from 100,000 tons a month up to 140,000 tons a month, and thus permit the company's huge mill to be more fully supplied with ore than it has been in the past. The shafts from which the ore is raised have a vertical depth of about 5000ft., while the load is 10,000 lb. of rock. Each skip weighs 7500 lb., and the rope, when fully extended, 27,500 lb., so that at the beginning of the wind a total weight of 20 tons has to be started on one drum, while the mass formed by the weight of rope wound round the other drum and amounting to about 12 tons, has also to be accelerated. The designed winding speed is 4000ft. per minute, and as only 15 sec. is allowed for acceleration from rest to full speed, it will be appreciated that very large forces have to be provided for. Put in rough figures the requirements amount to lifting 4½ tons of useful load, nearly a mile in less than a minute and a-half. As a matter of fact, the actual time occupied by a single wind is 87.5 sec., while records taken during continuous working, day and night, show that forty loads are brought up every hour.

This work is performed by two direct current electric motors, made by the General Electric Company of the United States, each of which has a normal rating of 2500 horse-power, when running at 106 revolutions per minute, and a combined overload capacity of 8600 horse-power. These two motors are coupled directly, as will be seen from the drawing, with the shaft of the winding drums, on which there are mounted, loosely, the two drums, each of which is 12ft. in diameter by 6ft. long. On these drums the rope, 1¾in. in diameter, is wound up to 3½ layers. The shaft is about 18in. in diameter, and is supported by three bearings 17in. in diameter by 20in. long, lubricated by an oil pump. The outside bearings for the motor armatures are of the ring oiling, spherical type, 14in. in diameter by 14in. long. The drum cheeks are cast steel made in halves and bolted together. The drum shell is made of mild steel. Each drum is fitted with a clutch having multiple teeth, so as to give a very fine adjustment to the rope. The clutches are operated by screw-down gear and levers.

The brakes are of the swung type built up of mild steel plates and channels lined with wood. They are operated by two compressed air double valve brake engines of the cataract type, the piston receiving air on the top when the emergency switch is tripped or an overwind takes place. A small auxiliary air compressor of a 100 cubic feet capacity is provided, together with a mild steel air receiver for supplying air to the brake engines in the event of the mine air failing. A solenoid safety device is fitted under the platform, so that in the event of failure of current, the brakes are applied by the solenoid core releasing a weighted lever connected to the brake engine valve.

The overwind gear and the retarding devices are operated through bevel and worm gearing from the drum shaft. The overwind gear consists of two discs, one for each drum, which revolve through 330 deg. during a wind. Each disc is fitted with a pin and roller which, at the end of the wind, comes into contact with a weighted adjustable trip lever, which operates the valve of the brake engine. The trip can be adjusted so as to come into operation at the required moment.

The drums are accelerated automatically by the motor starter, but are retarded by disc cams revolving through 330 deg. on the same shaft as the over-winding disc. There are two cams to each drum, one for winding men and one for winding rock. As they revolve these cams come into contact with levers, which act on to the controller through a connecting link. On the shaft to which the levers are keyed there is also a small clutch which, when the drums are working together, is engaged, but when one drum is unclutched, the small clutch is disengaged thereby breaking the connection between the control lever and the cams on that side. In order to start the winder the control lever is pushed over to full speed; the acceleration is then effected electrically. When the disc cam has revolved through the full speed period, it comes into contact with a lever which pushes the controller back to the centre position and thus brings the winder to a stop. Arrangements are provided, however, to permit the driver to accelerate the load as slowly as he desires, but he cannot accelerate it too quickly.

Power for the winding sets is provided by the company's own central station, and is transmitted to the mine head as alternating current, where it is transformed into direct current for supplying the winder motors, by means of two 5000 horse-power motor generators. The local representatives in South Africa of the makers of these hoists are Messrs. Blane and Co., Johannesburg.

Utilisation of Heavy Fuel Oils in Internal Combustion Engines.

By HAROLD E. MOORE, M.Sc. Tech.

IN a recent paper read before the North-East Coast Institution of Engineers and Shipbuilders, Mr. Harold E. Moore deals with some factors affecting the utilisation of heavy fuel oils in internal combustion engines, and he divides these difficulties into three classes, namely, ignition difficulties, difficulties in burning the oil after ignition has taken place, and difficulties caused by the presence of comparatively small quantities of impurities. For purposes of classification the author finds the following grouping of engines convenient:—

(1) Diesel engines; that is, engines utilising compressed air for injecting the fuel, and in which ignition is obtained solely by the heat of compression.

(2) Cold-starting engines; that is, engines in which the charge is fired by spontaneous ignition, but in which the fuel is pulverised by mechanical means without the use of blast air.

(3) Hot-bulb engines; that is, engines in which the fuel is injected by mechanical means, but in which external heat is applied in order to ensure ignition of the fuel.

IGNITION DIFFICULTIES.

In both Diesel and cold-starting engines the ignition of the charge is effected by the heat of compression of the engine, and it is therefore necessary that the temperature resulting from compression shall exceed the temperature necessary to bring about spontaneous ignition of the fuel. The author some years ago determined the temperatures of spontaneous ignition of various fuels, which he found to be as follows:—Petroleum oils: petrol, 270 deg. to 279 deg. Cent.; kerosene, 251 deg. to 253 deg. Cent.; gas oil, 254 deg. Cent.; residual oils, 259.5 deg. to 269 deg. Cent. Coal tar oils: commercial benzol, 566 deg. Cent.; commercial toluol, 516 deg. Cent.; creosote from gasworks tars 415 deg. to 473 deg. Cent.; creosote from low temperature tars, 290 deg. to 350 deg. Cent.; shale oils, 251 deg. Cent. Animal and vegetable oils: whale oil, 273 deg. Cent. Although there was comparatively little variation between

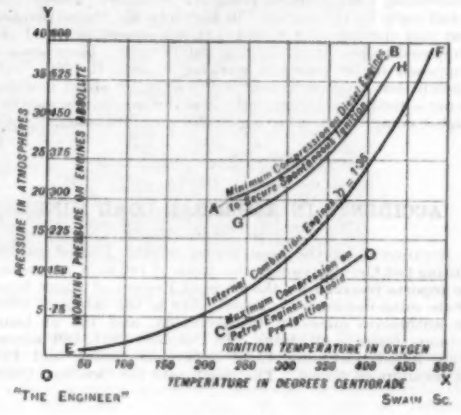


FIG. 1

fuels of the same type, there was great variation between the petroleum oils and the tar oils. The diagram reproduced in Fig. 1 show the limiting compressions of various fuels, the curves being prepared from the above-mentioned determinations.

The ordinates and abscisse in this diagram are pressures and temperatures respectively, and the line E F represents the temperature of compression calculated by the well-known formula,

$$T_2 = T_1 \left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}}$$

the value for n being considered to be 1.35, which is the approximate average value for water-cooled internal combustion engines.

Now, if the temperature scale be considered as the temperature of ignition of various fuels, it will be seen that in order to obtain ignition on a Diesel or cold-starting engine it is necessary that the compression pressure should exceed the corresponding pressure given by the curve E F. Therefore, the compression necessary for a fuel of any given ignition point must be such that when the two values are plotted the point must be above the curve E F.

In practice it is necessary to employ compressions considerably higher than the theoretical minimum. The lowest compressions that give satisfactory working with various fuels were found to lie roughly on the curve A B, which was constructed from experimental data.

Cold-starting engines do not require such a large margin of excess temperature, as there is no blast air to cool the combustion space, and therefore the compressions may be slightly lower, or roughly on the line G H.

Engines operating on the constant-volume cycle compress an explosive mixture in the cylinder, and if the ignition point of the mixture is attained in the cylinder spontaneous ignition takes place. It is therefore necessary to employ a compression lower than that denoted by the curve E F. In practice it is found necessary to use a much lower compression to ensure absence of pre-ignition, as in very hot petrol engines the value for n exceeds 1.35, and it is also necessary to counteract the effect of local high temperatures, such as hot valve heads, plug points, &c. The maximum limit for petrol engines lies roughly along the line C D, but the exact limits are much influenced by the design of the engine and by the nature of the service which it is built to perform.

Recent researches on petrol engine fuels have considerable bearing on the subject of heavy oil engine fuels. It is known that when high compressions are employed in petrol engines the phenomenon of "pinking" is encountered. Pinking is not actually pre-ignition, but is an effect produced by the extremely rapid propagation of the flame when the temperature of the explosive mixture approaches, perhaps not very closely, the ignition point. In their researches Midgeley and Boyd (*Industrial and Engineering Chemistry*, October, 1922, page 895) have found that many chemical substances exist which have the property of damping out the pinking effect in petrol engine fuel mixtures, one substance possessing 625 times the effect of benzol in this respect. By the use of such bodies the limiting compression may be raised and the line C D may be brought closer to the line E F by the reduction of the velocity of flame propagation. Midgeley and Boyd also find that bodies exist that aggravate pinking by increasing the velocity of flame propagation. It is quite possible that by future research on these substances it may become possible to employ treated fuel which will operate satisfactorily with lower compressions than those at present necessary in Diesel and cold-starting engines.

The ignition of the more refractory oils does not present difficulty in the hot-bulb engine, as the necessary temperature is easily available in the bulb. Any difficulties encountered in the use of the more refractory oils are more a question of burning than of the ignition.

The difficulty of obtaining firing on Diesel and cold-starting engines when running on oils of high ignition point has been to a large extent overcome by the use of pilot ignition gear, by which a small charge of easily inflammable oil is injected into the cylinder on each power stroke prior to the introduction of the main fuel charge. This arrangement necessitates the use of two fuel pumps. The consumption of the ignition oil—usually a petroleum distillate, such as gas oil—is from 5 to 10 per cent. of the total fuel consumption. It is possible to burn tar oils on Diesel and cold-starting engines by using a petroleum or shale oil for starting, and changing over on to tar oil when the engine has warmed up. This method is only satisfactory when the load factor is high, as tar oil is liable to misfire on low loads. It is also advisable to increase the compression ratio slightly and to advance the timing of the fuel valve. It is found that more satisfactory working is obtainable with tar oil if the first portion of the charge enters the cylinder without pulverisation. For example, the burning of tar oil is more satisfactory if used with ignition gear when both pumps are delivering the tar oil than when a single pump is used. The only possible explanation of this phenomenon is that the preliminary charge of tar oil is not pulverised. Efforts have been made to obtain this action without the complication of two pumps, and a device tried by the author is shown on the left-hand side of Fig. 2. By this appliance a portion of the opening of the needle valve is "masked," except for a small port, which allows a very restricted charge to pass to the combustion space. Further opening of the valve allows the main charge to enter the cylinder. It has also been observed that old engines in which the needle valve has sunk into its seating by repeated grinding-in, work very satisfactorily on tar oil. This is undoubtedly due to the shoulder on the valve seat producing a step in the fuel delivery. In all cases where such devices are used it is necessary to employ a heavy advance in the timing of the initial charge; the main charge should enter the cylinder about inner dead centre.

Oils and tars produced by low temperature distillation

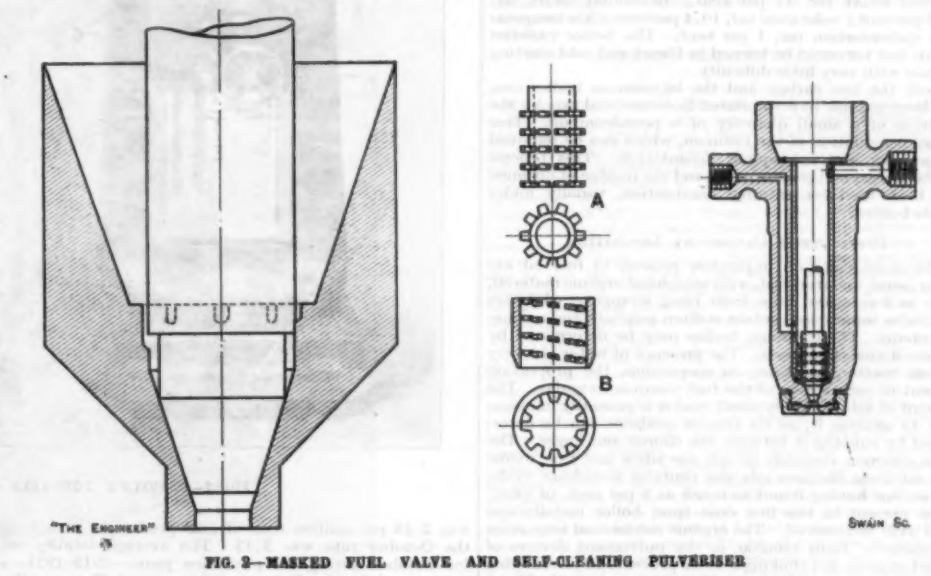


FIG. 2—MASKED FUEL VALVE AND SELF-CLEANING PULVERISER

are roughly intermediate between petroleum products and high temperature coal distillation products. If such oils were prepared in commercial quantities in the future it is probable that they will be burned in oil engines without pilot ignition gear.

DIFFICULTIES IN BURNING AFTER IGNITION.

In most cases the burning of the oil during the expansion stroke is a problem entirely separate from the ignition problem, but occasionally examples have occurred on

Diesel engines when a feeble start has influenced the burning during the remainder of the stroke. The author has known such examples to occur when the pulveriser settings are insufficiently restricted and the engine is running at medium loads with a low temperature of the circulating water outlet. The result is a smoky exhaust and a wavy expansion curve on the indicator card. The latter effect is liable to be incorrectly attributed to inertia of the indicator parts. Raising the temperature of the circulating water outlet generally puts the matter right. Probably in such cases the irregularity of the combustion is somewhat similar to the "roaring" sometimes observed in Bunsen burners and in oil burners used for furnace heating.

When ignition has occurred the rate of the burning of the fuel is dependent upon a variety of factors, which are independent of the quality of the oil. Such factors are compression pressure, cylinder dimensions, injection air, hot bulb, cooling water temperature, atomisation, engine speed and shape of the combustion space.

The slow-burning bodies present in petroleum and tar products are different in their constitution and must be studied separately. In crude petroleum the nature of the hydrocarbons and the waxes and bituminous bodies present are revealed by analysis, and attention must be drawn to the difference between oils containing soft asphaltum and those containing hard ashpaltum which is insoluble in petroleum spirit. Hard asphaltum is undoubtedly responsible for most of the trouble experienced in oil engines, such as the difficulty of obtaining a clear exhaust and the formation of carbon deposits in the engine. The following figures show the relative values of the components in various oils :—

Origin of oil.	Specific gravity.	Coke value.	Asphaltum. Soft.	Hard.
Mexican	0.966	12.08	20.58	16.43
Mid U.S.A.	0.899	5.98	4.75	0.8
Argentine	0.942	7.38	23.9	5.86
Texas	0.909	5.64	5.8	1.2
Barbados	0.970	7.26	5.8	1.02
Assam	0.968	—	23.99	2.58
Egyptian	0.959	9.69	19.55	13.05

Though bituminous bodies greatly increase the viscosity of an oil they do not raise its solidification point very seriously. On the other hand, waxes, although presenting no combustion difficulties, do raise the solidification point and cause the oil to become solid at low temperatures, interfering with the settling of the sand and water present. Petroleum distillates and shale oils present few difficulties, although the latter are often high in sulphur. Distillates of gasworks and coke oven tars also present little trouble other than the ignition difficulties already considered.

Raw coal tars have been utilised as fuel for Diesel engines on a large scale on the Continent. Their use in this country has been confined almost entirely to experimental work. The raw coal tars present the ignition difficulties usually encountered with coal tar products, but in addition they contain bituminous bodies, and a solid substance present in an extremely finely divided state, known as "free carbon." This substance is not actually carbon, but on analysis is found to contain about 2½ per cent. of hydrogen and 4½ per cent. of oxygen and nitrogen. Experience shows that free carbon burns much more slowly than the other portion of the oil, and unless the engine conditions are entirely favourable sparks will accompany the exhaust gases. The sparks are almost certainly burning particles of free carbon. This view is to some extent supported by the fact that when tars of high free carbon content are burned showers of sparks emerge if the indicator cock be opened. As might be expected, high free carbon content is frequently the cause of pitting of the exhaust valves in four-stroke engines ; two-stroke engines, exhausting through ports, do not suffer from this complaint. As the bituminous bodies present in a raw coal tar vary with the quantity of free carbon present, it is usual to value a tar by its free carbon content rather than by a direct determination of the bituminous matter. The following figures show the average free carbon content of a few typical tars. Vertical retort tar, 5.2 per cent.; inclined retort tar, 17 per cent.; horizontal retort tar, 20.8 per cent.; coke oven tar, 10.4 per cent.; low temperature carbonisation tar, 1 per cent. The better varieties of this last tar could be burned in Diesel and cold-starting engines with very little difficulty.

Both the free carbon and the bituminous bodies can, to a large extent, be precipitated from raw coal tars by the addition of a small quantity of a petroleum oil. This causes coagulation of the bitumen, which can be removed by settling and subsequent decantation. This process has been used on the Continent, and the residue of bitumen has been used for external combustion, usually under steam boilers.

Difficulties Caused by Impurities.

The most common impurities present in fuel oil are water, sand, and iron rust, with occasional organic material, such as leaves and fibre from bung wrappers, while tar distillates sometimes contain sodium sulphate and sodium carbonate. These foreign bodies may be determined by means of analytical tests. The presence of water is a very serious matter, as, being in suspension, the proportion present in each stroke of the fuel pump is irregular. The amount of ash is usually small, and it is generally unnecessary to analyse it, as its erosive qualities can be determined by rubbing it between the thumb and finger. The most common elements in ash are silica and iron oxide, and ash from Mexican oils also contains vanadium oxide, the author having found as much as 9 per cent. of vanadium present in the flue dust from boiler installations fired with Mexican oil. The organic mechanical impurities occasionally form trouble in the pulverising devices of Diesel engines, but choking may be prevented by modifying the usual design. The form of pulveriser shown in Fig. 2 has been found by the author to be free from trouble in this respect.

A cylindrical collar is fastened on to the fuel valve stem and moves with the fuel valve. This collar has been cut by vertical rectangular slots, and has also had grooves cut round it in a lathe in the manner shown in the sketch. This collar fits inside another collar, which is fixed in the bottom fuel valve casing and is therefore stationary. The outer collar is slotted internally to correspond with the external slots upon the inner collar, and, in addition to this, is grooved in the other direction not quite horizontally, but in the form of a screw thread, so that an angle is formed by the horizontal and inclined grooves on the inner and outer collars respectively.

When this device is working it will be observed that the obstruction to flow through the pulveriser is constant, whether the fuel valve is lifted or seated, but the direction of flow of the current is changing all the time during the period of fuel injection. The vertical grooves in both parts of the device are cleaned by the relative motion of the other parts. The formation of pulveriser deposits may not always be caused by mechanical impurities. In several cases the author has been led to think them caused by oxidation of some constituents of the oil, which might form deposits in the presence of high-pressure air, *i.e.*, under pulveriser conditions.

Water, ash and mechanical impurities can all be removed from oil by allowing the oil to settle with or without the application of heat. As this is a somewhat slow process, it has been found advantageous with certain of the more viscous oils to employ high-speed centrifuges to remove the water and the larger particles of ash and mechanical impurities.

The discussion of Mr. Moore's paper elicited some interesting contributions from the members present and a full reply by the author. In his reply Mr. Moore pointed out that the curves A B and G H reproduced in Fig. 1 are supposed to represent limiting values only. They are not supposed to be practical working figures, it being well known that a pressure that will just bring about ignition is not satisfactory for general use in the engine, a somewhat higher compression assisting in the actual burning.

ACCIDENTS IN AMERICAN COAL MINES.

Accidents at the coal mines of the United States during last October caused the death of 186 men, according to reports received by the Federal Bureau of Mines from State mine inspectors. Twenty-five of the fatalities were at anthracite mines in Pennsylvania, and 161 at bituminous mines in all states. In October, 1921, 180 miners were killed, including 42 at anthracite mines, and 138 at bituminous mines. The death-rate for October, 1922, was 3.46 per million tons of coal produced ; a year ago the October rate was 3.43. The average fatality rate for October during the past nine years—1913–1921—as determined by the Bureau of Mines, is 4.27 per million tons of coal mined, and the average number of lives lost during the same period is 238. The October, 1922, rate is, therefore, considerably below the average rate for October for the nine-year period. A gas explosion on October 20th at No. 11 mine, McCurtain, Okla., resulted in the death of 8 men. The loss of 186 lives in October brought the total number of deaths at coal mines during the first ten months of the past year to 1378, as compared with 1665 during the corresponding period of 1921. By a coincidence the fatality rates for the two periods are identical, *i.e.*, 3.92 per million tons. The output of coal last year had reached 352 million tons, while during the ten-month period in 1921 the production was 425 million tons. The year 1922 thus far showed an unfortunate increase in explosions of gas and coal dust. This unfavourable record was made notwithstanding the fact that a large part of the coal mining industry was shut down for five months in 1922 during the miners' strike. Accidents due to causes other than explosions showed no material change in frequency from those that occurred in 1921, except in the case of deaths due to the use of powder and other explosives, for which the rate declined from 0.315 to 0.187 per million tons.

Two New Drilling Machines.

Two interesting new designs of drilling machine have recently been completed by William Asquith, Limited, of Halifax. The first is a portable horizontal machine, the size and construction of which is such that it can drill, tap, or face internally inside circles down to 3ft. 6in. in diameter. The second is a heavy duty vertical drilling machine, in which handiness of operation has been made a special feature.

Portable Horizontal Drilling Machine.

Side and front views of the first named machine are given in Fig. 1. The machine is particularly suited for such work as drilling internal radial holes inside stator frames, being for this purpose lifted bodily into the interior of the casing without the casing being unbolted. In Fig. 2 we show the machine engaged on external work, namely, on drilling dowel pin holes in the end plate of the rotor for a turbo-alternator, the materials drilled through being half steel and half bronze.

The column of the machine is formed with four guiding ways for the drilling head, and is mounted so as to rotate about a vertical axis and to move horizontally. The vertical rotation is effected from the star handle A, to which is geared, through mitre wheels, a vertical shaft engaging through a pinion at its lower end with a fixed toothed ring in the base. A dividing plate of the milling machine type is associated with the handle A, and permits the drill to be indexed to 10, 14, 16, 18 or 24 divisions of a circle. This arrangement facilitates the accurate drilling of holes at 14 common angular pitches, and in some respects eliminates setting off. The horizontal movement of the column and its base covers a range of about 12in., and is effected by means of a ratchet lever.

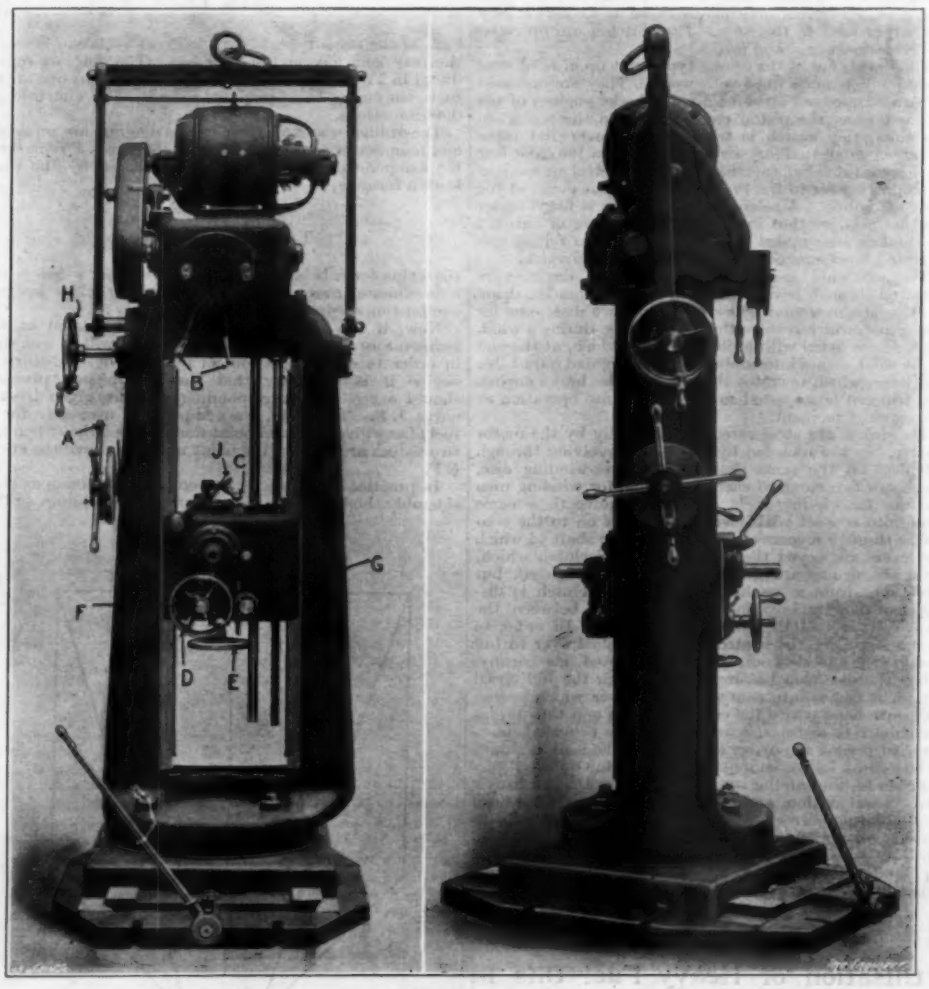


FIG. 1—ASQUITH'S PORTABLE HORIZONTAL DRILLING MACHINE

The machine is driven by means of a constant speed motor of about 5 horse-power running at 900 to 1000 revolutions per minute. The motor sits on top of the gear box at the head of the column, the drive being transmitted into that box through reduction gearing, and thence down a vertical spline shaft into the drilling head. By means of the two handles B eight different spindle speeds are available, namely, 24, 37, 50, 69, 106, 162, 224 and 306 revolutions per minute. The gear wheels

are made of hardened steel and run on shafts mounted in ball bearings. The starting, stopping, and reversal of the spindle motion is controlled by means of the handle C. The spindle is of high carbon steel, is 2in. in diameter at the driving part, and is supported in a sleeve with ball-thrust bearings and ball journals. Quick in-and-out adjustment of the spindle through a range of 10in. is effected by means of rack and pinion gear controlled by the hand wheel D. A fine hand feed can be applied to the spindle by means of the wheel E, while a self-acting feed transmitted through a worm wheel and hard steel worm can be brought into action by operating a control F at the centre of the quick adjustment wheel D. Three rates of self-acting feed can be selected by means of the dial G, the feed gearing being compactly arranged within the drilling head. The drilling head has a vertical adjustment of 3ft., the adjustment being effected by means of the hand wheel H, and can be fixed securely in any position by the locking lever J.

The particular machine illustrated in Fig. 2 is driven by a British Thomson-Houston motor, and is provided with a push button control at a point on the column convenient to the working position.

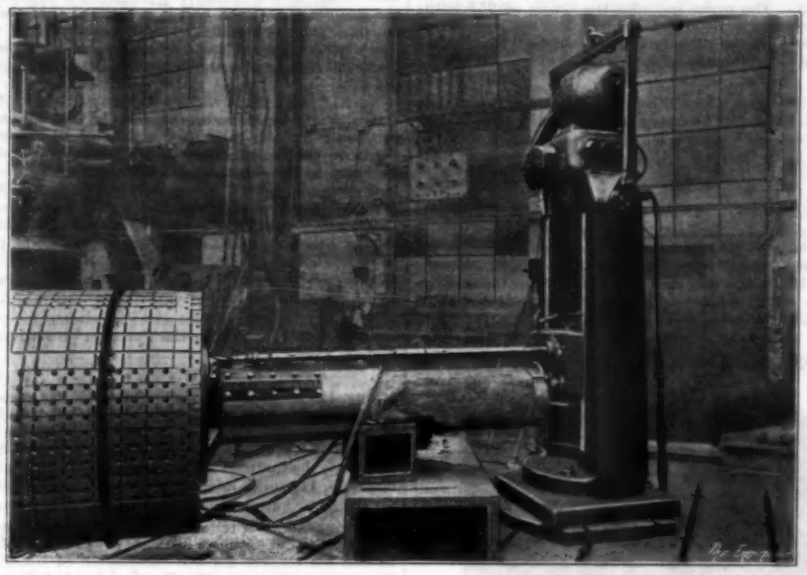


FIG. 2—PORTABLE MACHINE DRILLING TURBINE ROTOR

HEAVY DUTY VERTICAL DRILLING MACHINE.

In the design of high-speed radial drilling machines very great advances have recently been made with regard to such matters as cutting capacity, rigidity, durability, and handiness of operation. In the case of vertical drilling machines, however, progress has been less marked, particularly in the last-named connection, convenience of working. The new Asquith machine of this class—illustrated in Fig. 3—is claimed to have overcome the previously existing disadvantages, all the control and locking handles being so situated that the attendant can operate them without moving his position on the floor. In addition to securing this result, the designers have aimed at obtaining extreme ease and rapidity for all the adjustments. Once the work has been mounted on the circular table, shown in the engraving, it can be rapidly adjusted to any position, and any part of it brought under the spindle. The table, in fact, serves, it is claimed, in practically every way the same purpose as the usual form of compound work-table. It is not provided with elevating gear, the object of the omission being to secure rigidity. For varying heights of work packing pieces may be used, although in general the long feed of the spindle renders the use of such pieces unnecessary.

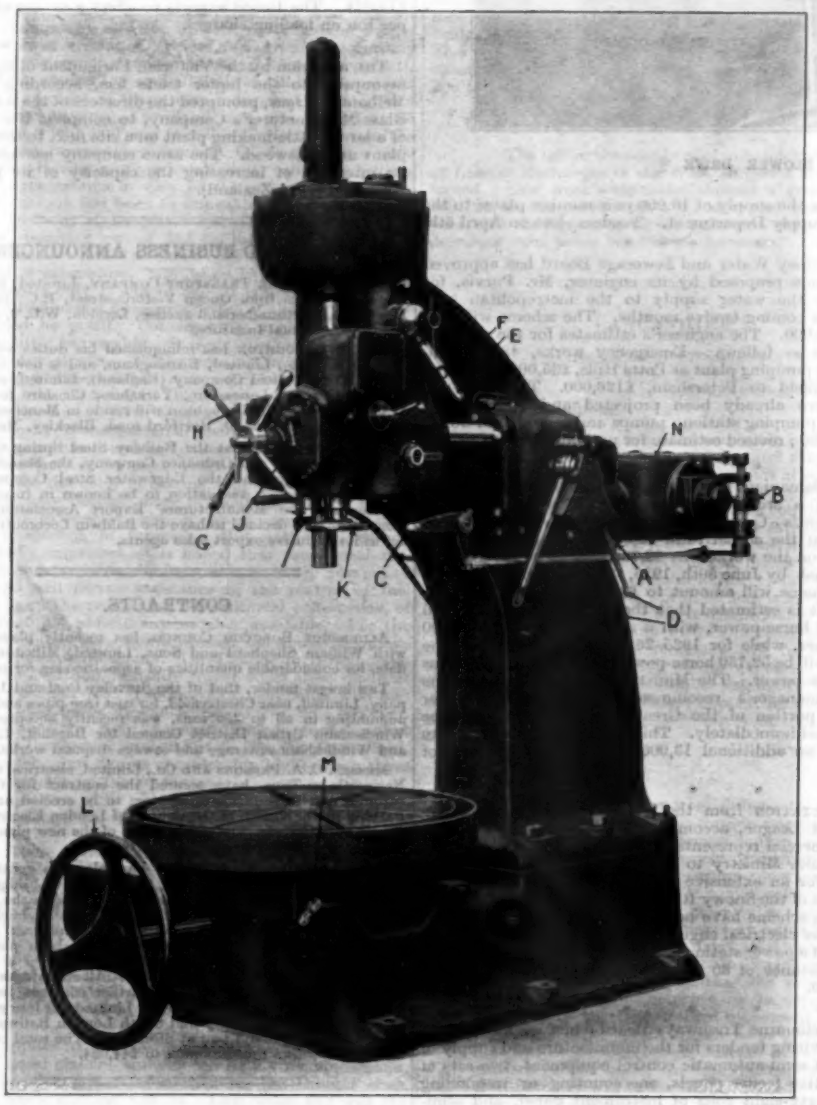


FIG. 3—ASQUITH'S NEW VERTICAL DRILLING MACHINE

The spindle is of the firm's customary design, that is to say, it is supported in a sleeve with ball thrust and journal bearings, for which it is advanced that great rigidity is secured even when the spindle is out at its full traverse. The drive is effected from a single pulley just visible at A, with which there is associated a stop, start, and reverse clutch operated through the rod B from the lever C. From the driving shaft power is transmitted through mitre wheels to a gear box furnished with two handles D, whereby any one of 18 speeds, ranging from 27 to 405 revolutions per minute may be given to the spindle. Actually the handles D have nine positions, the eighteen speeds being secured by means of single and double gearing controlled from the handle E. Four power-feed changes, ranging from 30 to 120 cuts per inch are controlled by means of the handle F. Rapid adjustment of the spindle is effected from the star handle G, which is engaged or disengaged at H. A fine hand feed is obtained from the handle K, the selection of the hand or self-acting feed being controlled from the lever J. The table is mounted on a ball thrust washer, and is rotated by hand. It can be traversed crosswise on its slide by means of the wheel L. The lock M serves to clamp the table both circularly and transversely. To ensure against accidents the clutch and the speed changing mechanism are interlocked by means of a rod N in such a way that the speed of the spindle cannot be changed while the clutch is engaged, that is, while the machine is running.

The machine is made in two sizes to admit work either 36in. or 48in. in diameter. In both cases a height of 2ft. 4in. can be accommodated between the top of the circular table and the spindle nose, while the hand and self-acting feed traverse is 1ft. 4in.

INSTITUTION OF NAVAL ARCHITECTS.

IT is announced that the annual meetings of the Institution of Naval Architects will take place on Wednesday, March 21st, and the two following days, in the Lecture Hall of the Royal United Service Institution, Whitehall, W.C. 2. His Grace the Duke of Northumberland, C.B.E., M.V.O., President, will occupy the chair. The annual dinner will be given on Wednesday, March 21st, at 7.30 p.m., in the Grand Hall, Connaught Rooms, Great Queen-street, Kingsway, W.C. The Council is arranging to hold a summer meeting of the Institution in Holland in September. A cordial invitation has been received from the Royal Institution of Civil Engineers at the Hague and the Nautical Technical Museum at Rotterdam, which will arrange for visits to be paid to the principal shipbuilding and engineering works at Amsterdam, Rotterdam, and Flushing. A gold medal will be awarded by the Council to any person, not being a member of Council or associate member of Council, who shall at the forthcoming meetings read a paper which, in the judgment of the Council, is deemed to be of exceptional merit. The Council will also offer a premium of books or instruments to the reader of any paper, not being a member of Council or associate member of Council, which paper, in the judgment of the Council, merits this distinction. The Council has awarded the gold medal for 1922 to Mr J. L. Kent, of the Froude Tank, for his paper, "Experiments on Mercantile Ship Models in Waves." Premiums have been awarded to Mr. E. Leslie Champness, M.B.E., M.Sc., for his paper, "Longitudinal Strength of Cargo Vessels and its Variation with Fullness of Form," and Major L. Fea, of the Royal Italian Navy, for his paper, "Some of the Consequences of the Washington Conference with Regard to Naval Construction." These awards will be presented on March 21st at the opening of the annual meetings, which will be held at the Royal United Service Institution, Whitehall.

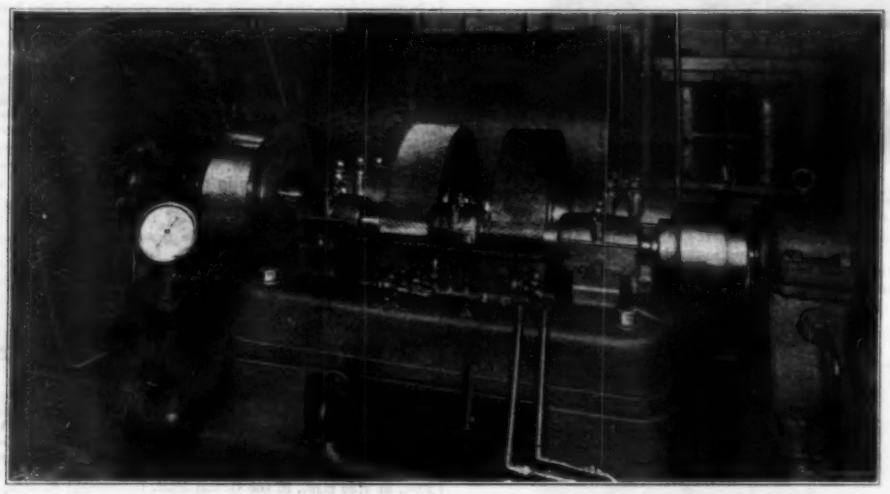
SIXTY-SEVEN YEARS' SERVICE WITH ONE FIRM.—In a recent issue we reported the case of Mr. Albert Williams, who had been with Alldays and Onions, Limited, of Birmingham, uninterruptedly for fifty years, and who was presented with a gold watch by the directors of the company in celebration of the event. The appearance of the report in THE ENGINEER, seen by a friend of a still senior veteran, caused that friend to communicate with Alldays and Onions, Limited, bringing to their notice the case of Mr. Joseph Maddox, who, although for some time retired, before doing so had completed sixty-seven years in the service of the company. The directors thereupon decided also to give Mr. Maddox a gold watch, which has just been presented to him. All his life Mr. Maddox was employed in the bellows shop, and from first to last Mr. Maddox was never absent from work for a single day excepting when ill.

UNIVERSITY COURSE IN PYROMETRY.—In a leading article in our issue for January 12th, we took exception to the rule-of-thumb methods of judging temperatures which are still far too common, and advocated the use of pyrometers. We are interested to learn that the University of Sheffield is now about to start, in its metallurgical department, a special course of instruction on pyrometry and modern furnaces for practical steel and other workers. A circular issued by the department states that the course is intended to provide the workers with an opportunity of obtaining a practical knowledge of the use and advantages in their daily work of furnace temperatures. For this purpose it is proposed to provide a number of modern furnaces as used in the Sheffield lighter trades, together with a selection of the most approved types of pyrometers, including radiation, optical, sentinel and thermo-electric, and to arrange for the practical demonstration of the use of these instruments, as applied to the forging, annealing and hardening of cutlery, files, edge tools, hack saws, &c. The furnaces provided are of various types, including gas, oil, coke and electric, and the students will, during the process of their work, pass from one furnace to another, so that they will acquire experience on each of the separate types, as well as a knowledge of the uses of the various types of pyrometers used in determining the furnace temperatures. The fees for the course will be an entrance fee of one guinea per student, together with a charge to be afterwards determined to each firm to cover the cost of the fuel used by the furnaces in the work which will be done by the students sent by the respective firms.

A Flexible Coupling.

AN interesting example of the application of a flexible coupling which we described in our issue of September 10th, 1920, is shown in the accompanying illustration. The device in question is known as a "compensating" coupling and is manufactured by the Wellman Bibby Company, Limited, of 36, Kingsway, London, W.C. 2, while the installation shown in the engraving is on board one of the pneumatic grain elevators belonging to the Port of London Authority, which were described at a meeting of the Institution of Mechanical Engineers by Mr. R. E. Knight.

The coupling itself, it will be remembered, takes the form of two discs keyed on to the ends of the two shafts to be connected together. The edges of these discs are formed into teeth, and a piece of spring steel, bent into the shape of a grid and then curved to the radius of the discs, is slipped into the spaces between the teeth to form the actual driving connection from one disc to the other. The spaces between the teeth are opened out towards the faces of the discs, which front one another in order to provide room for the members of the grid to bend and thus provide a certain degree of flexibility in the coupling. In the coupling as it was when we last described it the flaring of the tooth spaces was straight, but it is now curved so as to give a trumpet shaped opening. Otherwise the coupling



BIBBY FLEXIBLE COUPLINGS ON A BLOWER DRIVE

is the same as before. It is claimed for the new type of flaring that it produces a progressively shorter span for the unsupported part of the flexible grid, as the bending of the members is increased and thus enables the coupling to withstand heavy overloads without distressing the metal, while ample flexibility is retained at lighter loads. It is, in fact, said that these couplings will comfortably carry overloads five time as great as the normal, and it is probably this characteristic which has induced iron-masters to use them for such purposes as driving rolling mills. The whole coupling is, of course, covered in with a casing that is filled with lubricant.

The drive which we illustrate is a small one compared with some of those in which these couplings have been adopted, but it is interesting on account of the rather unusual conditions. There are, it will be seen, two couplings, one between the engine and gear-box and the other between the gear-box and blower. The engine is a Vickers heavy oil engine of 300 brake horse-power running at 300 revolutions per minute, the gear-box, by David Brown, increases the speed in the ratio of 1 to 10, while the blower is of the Rateau four-stage type, running at 300 revolutions per minute, and was made by Fraser and Chalmers.

When the plant was first put to work, with ordinary couplings between the three units, considerable trouble was experienced with the gear through the fly-wheel effect of the blower impeller resisting the cyclic speed variations of the engine and thus putting severe stresses on the gear teeth. The blower naturally tends to run at a constant speed, but the engine fly-wheel has, we are told, a cyclic speed variation of 5 per cent. The result with the original couplings was that when the engine was accelerating the forward torque in the transmission gear amounted to as much as four times the mean torque. When the momentum of the blower impeller was resisting the following retardation of the engine, a reverse torque about three times the mean was produced. The consequent reversal of stress in the gear was, only naturally, detrimental to its running and life. However, when the two Bibby couplings were fitted their resiliency absorbed practically the whole of the pulsations and the plant now runs quite smoothly.

Some other interesting examples of this type of coupling which are now being manufactured are for fitting between the turbines and gear-boxes of some geared turbine steamers, some others for the new X type of submarine, and a set for a cruiser.

JUBILEE EXHIBITION AT GOTHENBURG.—The city of Gothenburg, the principal centre of sea-borne trade in Sweden, will commemorate the tercentenary of its foundation by holding a Jubilee Exhibition this summer—the most important enterprise of its kind ever undertaken in Scandinavia. A number of other shows and fairs will be arranged contemporaneously by different organisations, including an international automobile exhibition and an international aero exhibition. In accordance with the rules laid down at the meeting of the Bureau Permanent International des Constructeurs d'Automobiles in November last, the Automobile Exhibition will be open during a period of five weeks commencing on May 9th and closing June 12th.

Australian Engineering Notes.

MESSRS. HOWE AND SIMMONS (H. and S. Electric Lighting Co.), 70, Charles-street, Launceston (Tas.), have secured the contract to instal electric light and power in the new woollen mills of Messrs. Kelsall and Kemp, Launceston. The order includes the fixing of 255 lights of approximately 20,000 candle-power, and the installation of ten electric motors from 40 horse-power. Nearly five miles of cable will be required.

* * * * * *

THE Wellington (New Zealand) Harbour Board has called for tenders for the construction of a new transit shed on the waterfront having a length of 706ft. and a width of 107ft. It is to be of structural steel, with concrete piers and panels.

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THE Melbourne and Metropolitan Board of Works recently invited tenders for the supply of 20 tons of 3in. and 1000 tons of 4in. cast iron water pipes of Australian manufacture. The Board has now placed orders for the pipes at £16 for the 3in. and £15 10s. per ton for the 4in. material. The contracts have been spread among a number of Melbourne firms.

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THE City Council at Newcastle (N.S.W.) is calling for tenders for the supply of 10,000 pole number plates to the Electric Supply Department. Tenders close on April 5th.

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THE Sydney Water and Sewerage Board has approved of a scheme proposed by its engineer, Mr. Purvis, for increasing the water supply to the metropolitan area during the coming twelve months. The scheme will cost over £700,000. The engineer's estimates for the required works are as follows:—Emergency works, 48in. main, £550,000; pumping plant at Potts Hills, £35,000; pumping main Ashfield to Petersham, £126,000. The following works have already been projected and approved:—Waterloo pumping station; pumps and motors and building, £24,000; revised estimate for pumping main, £70,000.

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THE Tasmanian Premier and Minister of Works has circulated a statement regarding the progress of the Government's Great Lake hydro-electric scheme. It shows that the actual total capital expenditure to June 30th last on the works was £2,786,957. The department expects that by June 30th, 1926, the total capital invested in the scheme will amount to £3,100,000. For the year 1922–23 it is estimated that the demand for power will be 46,450 horse-power, with a saleable surplus of 10,000 horse-power, while for 1925–26, it is estimated that the demand will be 52,750 horse-power and the saleable surplus 3700 horse-power. The Ministry entirely concurs in the general manager's recommendation that the Upper Shannon portion of the Great Lake scheme should be put in hand immediately. This work is expected to make available an additional 13,000 horse-power at a cost of £400,000.

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A DEPUTATION from the Twofold Bay (N.S.W.) Development League, accompanied if possible by shipping and commercial representatives, is to wait upon the New South Wales Ministry to endeavour to secure fulfilment of plans for an extensive hydro-electric scheme whereby the waters of the Snowy River would be harnessed. Plans for such a scheme have been prepared by the New South Wales chief electrical engineer. Provision is made for the erection of a power station and transmission line to Twofold Bay, a distance of 80 miles, at a cost of approximately £1,500,000.

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THE Melbourne Tramways Board (chief engineer, H. S. Dix) is inviting tenders for the manufacture and supply of one set of semi-automatic control equipment, two sets of auto-positive feeder panels, one counting or responding device, forty-eight rolls of instrument paper, and semi-automatic control spares. Tenders close on February 28th 1923. Current supplied to the sub-station is received at from 6000 to 6600 volts, 50 cycles, three-phase. The rotary converter sets to be controlled consist of one three-phase oil-insulated transformer, with delta connected primary and six-phase secondary, of 550 kilovolt-ampère capacity.

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THE South Australian Supply and Tender Board, Adelaide, has invited tenders for the supply and delivery of steel superstructures for bridges on the Adelaide to Terowie railway line.

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THE New Zealand Government engineers are investigating a request made by the Egmont Power Board for a licence to develop 2000 horse-power at Taranaki on the west coast of the North Island. The estimated cost of the project is £60,000, and it is claimed that the scheme, which could be extended to 20,000 horse-power, would be one of the cheapest in the Dominion. Mr. Birks, chief electrical engineer to the Government, is in charge of the inquiry.

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THE Victorian House of Assembly has adopted a Bill providing for the raising of a sum of £1,576,000, to be spent on the works of the State Electricity Commission. Included in the sum total are £760,000 for additions to the main scheme, power house, &c., at Yallourn (Morwell); £120,000 on extensions of the transmission line to the south-west of the State; £50,000 for the Sugarloaf hydro-electric scheme; and £70,000 for an electricity project in Gippsland, beyond Morwell.

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TENDERS closing April 30th, 1923, are invited for the supply and delivery of protective apparatus for generating end of parallel feeders for the Pyrmont power house of the Sydney City Council.

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THE House of Assembly in Victoria has passed a Bill providing for the construction of a railway line from Hopetoun to Patchwallock, a distance of about 28 miles, at a cost of £130,000, while the Western Australian Assembly has agreed to a measure which provides for a new line, 113 miles long, from Jarnadup to Denmark.

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ACCORDING to a remark made by Sir William Harries, it is likely that Cabinet authority will be shortly sought to call for tenders for the completion of the Taupiro to Tauranga railway in the North Island of New Zealand. In such case the Government would doubtless fix a time limit for the completion of the work.

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THE Harbour Board at Cairns (Queensland) has decided to instal a conveyer at the local wharf for the delivery of sugar into ships' holds. The scheme is estimated to cost £31,800, and provides for a conveyer plant, £13,396; steam power, £4380; 6000-ton storage shed, unloading shed, alterations to existing structures, foundations, &c., £14,024. The Board expects to effect a saving of 3s. 6d. per ton on loading charges.

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THE adoption by the Victorian Parliament of legislation favourable to the liquor trade has, according to the Melbourne *Argus*, prompted the directors of the Australian Glass Manufacturer's Company, to complete the erection of a large bottle-making plant on a site next to the present plant at Spotswood. The same company has announced its intention of increasing the capacity of its plant at Auckland (New Zealand).

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE MOTORAILER TRANSPORT COMPANY, Limited, has transferred its offices from Queen Victoria-street, E.C., to Avenue House, 21, Northumberland-avenue, London, W.C. 2, adjoining the Royal Colonial Institute.

MR. H. BROUGHTON has relinquished his duties with E. G. Wrigley and Co., Limited, Birmingham, and is now associated with the Poldi Steel Company (England), Limited, as district manager for the Lancashire, Yorkshire, Cheshire and North Wales District. Mr. Broughton will reside in Manchester. His temporary address is 30, Hertford-road, Blackley, Manchester.

WE are informed that the Railway Steel Spring Company, the Midvale Steel and Ordnance Company, the Standard Steel Works Company, and the Edgewater Steel Company have decided to form an association to be known in future as the "American Tire Manufacturers' Export Association." This Association has decided to have the Baldwin Locomotive Works act as its exclusive export sales agents.

CONTRACTS.

ALDERSHOT BOROUGH COUNCIL has recently placed orders with William Shepherd and Sons, Limited, Milkstone, Rochdale, for considerable quantities of asphaltic slag for roads.

THE lowest tender, that of the Staveley Coal and Iron Company, Limited, near Chesterfield, for cast iron pipes and specials, amounting in all to 350 tons, was recently accepted by the Windlesham Urban District Council for Bagshot, Lightwater and Windlesham sewerage and sewage disposal works.

MESSRS. C. A. PARSONS AND CO., Limited, electrical engineers, Newcastle-on-Tyne, have secured the contract for the steam turbines and three-phase alternators to be erected at the new Barking power station of the County of London Electric Supply Company, Limited. The total output of the new plants will be between 90,000 and 100,000 kilowatts.

THE UNDERGROUND COMPANY has placed a contract with Messrs. John Butler and Co., of Leeds, for five bridges on the Edgware and Hampstead Extension line, now in the course of construction. Two of these bridges will cross Highfield-avenue and Shirehall-lane. The amount of the contract is £8432. Another contract, amounting to £757, has been placed with E. C. and J. Keay, Limited, of Birmingham, for a bridge to carry the line under Colindale-avenue. All six bridges are to be completed in twenty weeks. A further contract for £34,865 has been placed with Waygood Otis, Limited, for four escalators, to be installed on the City and South London Railway, two at Clapham Common and two at Stockwell. The total cost of the above new works thus amounts to £44,054.

SAFE DOORS.—At the invitation of Messrs. Chubb and Son's Lock and Safe Company, Limited, we recently attended a luncheon, after which there was shown a cinematographic film representing the manufacture of a large door for a banker's strong room. The whole process was depicted right through from the steel refinery. Two of the most striking scenes in the film were one when a plate of the special alloy used for these doors was tested with an acetylene blow-pipe, but resisted all efforts to penetrate it; and another showing how a small boy easily closed the door itself, although it weighed some 17 tons. The weight of the door is carried on roller bearings.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The Trade Situation—A Disturbing Element.

THE upward movement in the iron and steel trade has been well maintained, but the market is disturbed by the confusion which has arisen as the result of the crisis in the Ruhr. It is generally conceded that the turn which events have taken is inimical to the development of the new trade movement. Returning confidence has received a serious check. Promoters of undertakings involving large expenditure hardly consider this the propitious time to give out contracts. Constructional engineers in this district state that there has been a marked falling off in inquiries and new business during the past week. The recoil must not be attributed entirely to the continental situation. It is what one would expect from any rearrangement of prices. Values, though confused, are mounting in most departments of the market, with each passing day, and where there is pressure to buy substantial price advances are being conceded. Before this trouble in the Ruhr the prices of iron and steel were undergoing a levelling-up process. It is more than likely the upward movement would have continued for a time, apart from any trouble on the Continent, but the new complication has given the market a fresh attack of nerves. A good many producers have practically closed their books, forward business being attended in the present circumstances with risks which they do not care to take. There can be no doubt the new anxiety which has clouded the outlook is putting a stop to negotiations in many directions.

Pig Iron Scarcity.

There is much speculation as to the prospects of a really serious pig iron famine developing now that inquiries from the Continent and from America are coming forward to augment the home demands upon an industry which has but a small portion of its resources in action. The somewhat sudden buying movement in this department has found the country without any reserves whatever, either of iron or steel-making pig irons. It would appear that the pig iron "squeeze," the possibilities of which have for some months been discussed in well-informed circles here, has come to pass. There were more buyers than sellers on the Birmingham iron market to-day (Thursday), and the upward movement of values was sharply accentuated. Prices varied widely according to individual circumstances. Some smelters were practically off the market, others had little to sell for the present quarter, and most of them were indisposed to enter into far-off commitments. Cleveland iron was quoted at £5 by those few who had any to sell, and Northamptonshire and Derbyshire irons were from 2s. 6d. to 5s. dearer than last week. Hardly any pig iron making concern is willing to open negotiations in view of the present uncertainty. Pig iron making has been so unprofitable for a long time that at the end of December last there were only 133 furnaces operating out of 385 taking the country as a whole. Durham and Cleveland have 37 operating out of 115, and Staffordshire, Shropshire, Worcestershire and Warwickshire only 17 out of 58. It is notorious that for many months past a large proportion of the pig iron made has carried no profit. Consequently, makers have produced as little as possible. It is stated that in no district are there any stocks. All the iron in Cleveland has been cleared, and America has now reappeared with orders for No. 3 brand. Some of this business has been passed on to Derbyshire. With output far below the normal, and the recent crystallisation of the market, the production for the quarter has been largely bought up. In this district there are plenty of furnaces available. The high cost of coke and the difficulty in getting supplies, which smelters are afraid may become more pronounced in view of the continental exigencies, are, however, serious obstacles to the re-starting of furnaces. But with the outlook undoubtedly improved, it is hoped that some local furnaces which have been idle for a long time will now get to work, and will derive assistance in the matter of fuel supplies from the re-starting of additional coke ovens, of which there are almost any number available. For the present, smelters are being pressed by would-be buyers to enter into commitments. On 'Change in Birmingham to-day, for Northamptonshire forge, offers were made at between 74s. and 75s. Producers or merchants who had supplies could probably exact 76s. to 77s. 6d., however. Northamptonshire No. 3 changed hands round about 80s., while Derbyshire fetched 89s. to 90s., North Staffordshire was 90s., but figures considerably higher than these were quoted for particular makes.

Staffordshire Bar Irons Appreciate.

There is more activity at the Staffordshire ironworks, largely arising out of the improved demand for material from the local wagon-building concerns. The increased demand, coupled with higher production costs, is enabling bar makers to secure a price a little more remunerative than has been the case of late, though they are still unable to make the same addition to their quotations as the Lancashire and Yorkshire houses. Staffordshire Crown bars have this week been making £11 to £11 5s., being an advance of 5s. per ton on last week's figures. There are buyers, however, who claim that they can still obtain supplies at £10 15s. Nut and bolt bars, too, are dearer. Local makers, emboldened by a growing demand, for the heavier rather more than for the thinner sizes, are this week quoting £10 5s. Last week £10 was the accepted firm price. Makers in the Lancashire area who compete with local makers for the Staffordshire trade are now asking £10 10s. for nut and bolt iron, and up to £10 15s. for fencing material. They are moving appreciably faster than Staffordshire firms, who, it may be, are less favourably placed in the matter of orders. Very little is heard of continental material, but small parcels of No. 3 Belgian iron continue to come into the district at £8 2s. 6d.

Galvanised Sheets.

Galvanised sheets are firm. Sellers seldom quote less than £18 10s., and affirm that they are getting that price for 24 gauge corrugateds in bundles at ports. This is by no means the rock-bottom price, however, and business is still accepted by some makers at £18 5s. For 26 gauge the extra amounts to 35s., and for 28 gauge 15s. on top of that. When it comes to 30 gauge the ratio of increase is greatly added to. The black sheet trade is busier, chiefly owing to the demands of the motor trade and the various Birmingham industries using sheets as raw material.

Rising Steel Prices.

The steel industry is quite bright, and there are more orders being placed, both for finished material and half products. Finished steel is again dearer, being advanced this week by some Staffordshire producers by 5s. per ton. These firms quote angles at £9 10s., tees £10 10s., and bars £9 15s., while £9 17s. 6d. is asked for plates. It is not a concerted movement, however, and last week's prices are accepted by some makers. Staffordshire steel hoops have settled on the increased basis of £11 10s., notified a week ago. The increase, amounting to 10s. a ton, was not surprising considering that makers are now asked to pay 15s. to 20s. a ton more for their billets than at the beginning of the year. Demands in respect of constructional engineering are not much in evidence. Constructional engineers in Staffordshire are not keen buyers just now, building enterprises having found their way to other than Midland areas. There is an improved demand for semi-finished material, however, and it is almost impossible to buy billets under £8. Some firms demand £8 5s., and others even up to £8 10s. There are no offers from the Continent regarded as likely to yield early deliveries. Belgian firms have no desire to renew contracts for semi-finished material. The exception is No. 3 iron for nut and bolt making, still obtainable here at £8 2s. 6d.

Steelwork Contracts for Tipton Engineering Firm.

The Horseley Bridge and Engineering Company, Limited, Tipton, Staffs., one of the most important firms in its line in the Midlands, has, I learn, secured sufficient orders to justify the management reverting to full time. This firm has secured the contract for the steel work for two of the new bridges on the Golder's Green-Edgware Underground Railway extension, London. The amount of steel work involved will be about 400 tons, the largest single members to be conveyed to the site weighing 25 tons each. Another contract the firm holds is one for three bridges for the Buenos Ayres and Great Southern Railway. This represents 900 tons of steel work, and involves the construction of bridges of 300 m. spans, each weighing 300 tons.

Unemployment Still Decreasing.

The fall in the numbers of unemployed registered at Labour Exchanges in the West Midlands area is maintained. Last week's statistics showed a grand total of 169,724, as compared with 176,354 at the opening of the year, and the figures up to the 22nd inst. reveal a further decrease, there being 165,709 on the books.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Conditions.

FURTHER progress has been made in the upward tendency of prices since I last wrote, and this, although satisfactory from one point of view, is not altogether so if one considers the urgent need which exists for the expansion and broadening of trade. What the commerce of the world needs is not rising prices, however satisfactory they may be to speculators, but lower prices and more business. The cause of the rise in many of our prices is, of course, the disintegration of continental industry, and this cannot be a real advantage to the world. There is no doubt some improvement in trade here, but it will probably be checked very soon if it leads to any further increase in the costs of manufacture, and the tendency will be to increase American industrial activity at our expense. The engineering trade of Great Britain is especially in need of moderate prices for all metals. Copper, no doubt, is low enough, but this cannot be said either of iron and steel, or of lead and spelter.

Metals.

The sudden change from dulness to activity in the standard copper market is rather puzzling because there does not seem to be any corresponding improvement here in consumption, or any prospect of such improvement in Europe generally. There is perhaps some movement in this direction in America, but this of itself ought not to have much effect. Hence it is believed in some quarters that Stock Exchange manipulation may be at the bottom of the activity in copper. In fact, it is reported that there has been some Stock Exchange buying of standard copper with the view of influencing the share market. If this is the cause of higher prices in the copper market one might assume that the upward movement would not last very long. There would appear to be great diversity of opinion on the London copper market as to the immediate prospects of the trade. In America there is a growing belief that industry will be very much more active in 1923 than it was in the previous two years, and this may very well be the case; but any extra consumption of copper resulting from such activity will be counteracted by a lessening consumption in Europe. The world is not yet rich enough to consume copper as it used to do. The market for tin has again been very strong, and the larger buying in America has had a stimulating effect on prices, so that people who were foretelling a level of £200 per ton are again more confident. It is probable, however, that if such a price should be reached it will draw out more of the reserves of stocks in the East. The demand for tin from the Welsh tin-plate works has been a little better this week. The sharp rise in lead, which occurred at the end of last week, is said to be the result of the advance in the American market. The price there has been put up to 8 cents per pound, which at the present rate of exchange is over £34 per ton, and is expected to draw Mexican supplies away from our market, and effectively stop the chances of increased deliveries. It is noticeable that the backwardation on three months' lead is now reduced to very small proportions. One fears that dear lead will be one of our industrial troubles for some time. The demand here for spelter has been better, especially from the galvanisers, and the price is tending upward again. People say that spelter is dear, but in relation to lead it is not at all expensive. There has been some Belgian metal coming in, but nothing from Germany.

Pig Iron.

The markets for pig iron are upset by the news that more continental furnaces are being stopped, owing to the troubles in the Ruhr Valley, and it does not seem improbable that a further demand for British pig iron may be the result. Already the supplies of Cleveland No. 3 seem to be exhausted, and there appears to be a difficulty about blowing in more furnaces until a further supply of coke at a reasonable price can be assured. The Durham coke is being drawn away from the district by the high price for export, which has now reached 37s. 6d. per ton. In Manchester the price of foundry pig is still only about 95s. (against 105s. now quoted f.o.b. for Cleveland), but consumers do not follow the advance very readily, and this is probably because many of them have yet a good deal to come in at 90s., and in some cases at less. Still, it is not surprising that the Midland makers should insist upon higher prices when they see what is being paid in the Cleveland district. The price of Scotch iron here is a little stiffer, but there is very little business, as most founders are now unable to afford Scotch iron.

Steel.

The market for finished steel is certainly stronger here, but the chief effect of the failure on the part of continental works is to be seen in the North-East and in Scotland. Not only are Indian and Japanese inquiries for steel coming to British works in much larger numbers, but even the Continent is now inquiring for it. There was at least one inquiry from Holland for British steel plates, which seems to show that the consumer had given up the hope of getting what he wanted from Belgium or Germany. One cannot tell yet what is going to happen in this department of the trade.

Scrap.

The market for scrap iron and steel is steadily increasing in strength, but it is still troubled with too much cast scrap. Dealers here are trying to get 85s. per ton for broken machinery metal, but they do not sell very much, and there are still some cheaper sellers in the market. The price is now fully 10s. per ton less than it ought to be in comparison with pig iron.

The Engineering Trades.

The slight improvement which started to manifest itself in most branches of the local engineering industry towards the end of 1922 is still maintained. A fair amount of new business has been booked during January in constructional engineering, cranes and railway rolling stock work. Machine tool makers, boiler makers, and the lighter branches of the electrical trades are still badly off for work. Textile machine builders are well employed. There is a much better outlook as regards railway work generally, and it would appear that the engineering departments are now in a better position to place orders than they have been at any time since the war. This will be good news for the local machine tool builders. The great need now is for more settled conditions in international affairs, the outlook for which is far from reassuring.

Reduction in Gas Prices.

At the meeting of the Gas Committee of the Manchester Corporation held last week it was decided to recommend a further reduction in the price of gas of 6d. per 1000 cubic feet, bringing the price to the ordinary consumer down to 3s. 5d. per 1000. There has now been a total reduction in the price equal to 1s. 1d. per 1000 cubic feet. Large consumers will pay 2s. 7d. per 1000 cubic feet.

Liverpool Engineering Society.

The annual dinner of the Liverpool Engineering Society was held at the Adelphi Hotel on Thursday, 25th ult. There was a very large attendance of members and friends. Professor T. B. Abell, the President, occupied the chair, and amongst the guests were Sir Archibald Ross, President of the North-East Coast Institution of Engineers and Shipbuilders; Dr. H. S. Hele-Shaw, President of the Institution of Mechanical Engineers; Mr. Harold Yarrow, President of the Institution of Engineers and Shipbuilders in Scotland; Mr. J. Sandeman Allen, chairman of the Liverpool Chamber of Commerce; Mr. T. Rome, chairman of the Mersey Docks and Harbour Board; Mr. H. Graham White, Member of Parliament for Birkenhead; and the Lord Mayor of Liverpool, Councillor F. C. Wilson. In reply to the toast of "The City of Liverpool," the Lord Mayor said that Liverpool was handicapped in comparison with other ports by excessive railway rates. He complained that the rates between Liverpool and Birmingham were one-third more than they were between Bristol and Birmingham, and nearly one-third more than those between Hull and Birmingham. He said that this state of affairs could only be remedied by having other modes of transit than the railways. He said they were proud of what the engineers had done for the city, and he looked forward to greater progress in the future. The toast "Our Guests" was proposed by Mr. W. E. Mills, and responded to by Colonel A. Buckley. The toast of "The Liverpool Engi-

neering Society" was proposed by Dr. H. S. Hele-Shaw, a past President and life member of the Society. He said that there were at the present time between thirty and forty different engineering societies, and that the "great four," the Civils, Mechanicals, Electricals and Naval Architects, had now formed a Council to deal with matters affecting their common interests. Professor Abell, in responding, referred to the fact that the Liverpool Engineering Society had acquired premises of its own in which it would hold its meetings in the future.

Manchester Association of Engineers.

There was a very large attendance of members of the above-named institution on Friday last to receive the report of the Lathe Tools Research Committee by Mr. Dempster Smith. As copies of the report had only been in the hands of members for a day or two it was not anticipated that there would be many speakers on such a big subject. The reading of a *résumé* of the report by Mr. Dempster Smith occupied about one and a-half hours, and the President, Mr. Daniel Adamson, put it to the meeting that another evening should be devoted to the discussion. This was agreed to. A special word of praise is due, however, to the reader for the very interesting and lucid abstract which he placed before his audience. As Mr. Charles Day tersely expressed it, the task which Mr. Smith had accomplished in boiling down the work—mainly his own—of nine years into the space of an hour and a-half was a most creditable performance. Mr. Day said that the report was not made with the object of creating records in tool steel performances, but rather to demonstrate what could be done with ordinary tools operating on mild or medium steels, the results being brought down to a quantitative basis.

BARROW-IN-FURNESS, Thursday.

Hematite.

The trade in hematite pig iron is steadily improving. Inquiries are keener, and there is a much better inclination to place orders than there was. This is due to the fact that the impetus given to trade is sending up the price, and many likely customers have been hanging back waiting in vain for cheaper iron. They now find themselves in the unfortunate position of having to give more, but they are not waiting now. Some time ago inquiries were very numerous, and one maker expressed the opinion that if all inquiries came off he would be very busy, but then there was the inclination to hang back. Now there is an insistent demand for iron that can only have one result, the putting in of more furnaces. It was thought by some that the American trade was a flash in the pan and due to a very great extent to the coal strike, but another order for 10,000 tons of pig iron has just been placed with a North-West maker, and it is such orders as these that help to stiffen the market and bring the laggards in with a rush. Makers would like to increase the number of their furnaces in blast, for then the costs could be reduced. At more than one works furnaces are prepared and only require starting. Special qualities of iron are in good demand. The trade is good all round, and heavy deliveries are not confined to one district.

Iron Ore.

The iron ore trade is very good and better than it has been for a considerable time. The Barrow Hematite Company is starting its Yarlside pit, which has been idle since 1921. There are signs of further improvement in the iron ore trade within the immediate future. Foreign ore is still coming in in minimum quantities, but when stocks are down at the docks an impetus will be given to the importation of Spanish and other ores.

Steel.

The steel trade is not so brisk taking the district generally. The Barrow rail mill has work that will take it to Easter, and further orders may be secured in the interim. The Workington rail mill has stopped, and at the moment there is not much sign of its recommencing. Foundries are experiencing better business. The hoop mills at Barrow and also the new mill for small rods, &c., are well engaged, and are likely to be. The latter mills are finding the eight hours' shift most successful. The men are well satisfied with the arrangement, which seems to be working out well for both employer and employed.

SHEFFIELD.

(*From our own Correspondent.*)

Activity in Heavy Steel.

IN the steel trade generally, somewhat quieter conditions prevail this week. The number of new orders shows a falling off, and it would appear that the situation in the Ruhr has affected the confidence of users of material, and made them disinclined to book supplies beyond what they need for immediate requirements. The heavy steel branches continue to show much activity, and an excellent tonnage of billets is being turned out. Confidence in the future is unabated. The Master Cutler, who is a manufacturer of railway material, has several times spoken in optimistic tones since his election three months ago, and last week he took occasion to repeat his belief that a steady general expansion of trade could be looked for within the next few months. Mr. S. J. Robinson, managing director of William Jessop and Sons—a branch of the Birmingham Small Arms Company, which was closed for some time during the worst of the slump—states that his firm is extending operations, and putting more men on, while the wages sheet is increasing every week. Mr. Robinson, by the way, has just been elected a member of the Sheffield City Council. Jessops' are large manufacturers of forgings and castings, special alloy steels, crucible cast, high-speed and carbon tool steels. Railway material is still one of the busiest branches, and, although no large new orders have been reported since I last wrote, there is a great weight of work on hand. It is not, however, nearly sufficient to keep all the plants fully occupied, for, as previously pointed out, there have been great extensions during the last few years.

Coal and Coke Prices.

It is greatly to be hoped that the fears of a coal famine which have been expressed will not come true, for any shortage which led to a material increase in the price of coal for home consumption would have a disastrous effect on our reviving industries. Coalowners recognise this, and, although they might possibly be able to get rather more for their supplies now, they are not asking any more, as they have no desire to interfere with the progress of trade. There is, however, a suggestion that coke prices are too low. The principal variety of coke produced in this district is that used in blast-furnaces, which are now busily at work producing as much pig iron as they possibly can for the home market, for America and also for the Continent. Blast-furnace coke is consequently scarce, and it is pointed out that the price is below the pre-war ratio of values as between coke and the cost of coal production. The ratio of values of July, 1914, a coal and coke producer told me, would place Yorkshire blast-furnace coke to-day at about 27s. a ton, whereas the quoted value is about 23s.

Steel and Steel Materials.

The prices of both acid and basic steel billets have gone up during the past week, the former by £1 per ton, and the latter by 10s. The activity of the furnaces has given increased strength to the scrap market, and supplies are very short owing to exportations to Germany, which took place in large quantity a year ago when the home trade was so bad. Instead of the 40s. a ton which ruled then for good old heavy steel scrap, or the 70s. which was considered a top figure quite recently, as much as 85s. or 86s. is now being obtained, and there are occasional transactions at even higher figures. There have been advances in value, too, of old wrought iron, cast iron, and turnings.

Colliery Developments.

The wagon builders are very busy dealing with orders from collieries in Yorkshire, Derbyshire, and Nottinghamshire, and thousands of vehicles are being turned out of shops which have not had any orders for new work for a long time. The prospects of continued demands from the collieries are improved by the many pit developments that are in progress. Seldom a week passes without news becoming available of some great colliery development scheme in the district. Last week I referred to the Butterley Company's important project at Ollerton, in the Dukeries district of Notts, and now particulars are to hand of the advances made by the Bolsover Company in exploiting the coal resources of another part of the same district. This company, which already controls large collieries at Bolsover, Creswell, Mansfield, and Rufford, is sinking new pits at Clipstone and Thoresby, in the Sherwood Forest district.

Great Nottinghamshire Schemes.

At the Clipstone Colliery, coal was reached by one shaft as long ago as April last. Delay occurred with the construction of the other shaft, and this has hindered the early development of the colliery. The shafts are now down to a depth of 640 yards, and between 400 and 500 men are already employed. Headings are being driven, and as the development proceeds the number of men employed will be increased to a final total of 2500. Already a small amount of coal has been produced. The pit bank and shaft equipment will be of the most up-to-date kind. Westinghouse decking rams, worked by compressed air, are to be installed, and these will enable the coal, as it is brought up on the cages, to be conveyed by pipe direct to the screens. Besides making for the safety of the men, these modern appliances will enable the coal to be cleared much more expeditiously. The colliery company is building 600 houses in the neighbourhood. At Thoresby, boring is in progress, to prove the upper measures. This pit is not far from the Major Oak, one of the most charming spots in the Forest, and, in order to avoid the erection of chimneys and boilers, and the destruction of the vegetation by smoke, it has been decided to work the new colliery entirely by electricity, which will be brought to the site by a high power cable. The colliery company has acquired Edwinstone Hall, which is being fitted up as a recreation, educational, and social centre. Accommodation for ninety is being provided, and a male and female welfare superintendent have been engaged. The developments which are taking place in Nottinghamshire are expected to increase the annual output of coal by 10,000,000 tons, and to provide employment for 25,000 more men and boys.

In Yorkshire.

Progress is being made with the sinking of a new shaft at the Prince of Wales Colliery, Pontefract. It is designed to reach the Beeston seam of coal, which lies at a depth of 1920ft., and has already been taken down some 400ft. The sides of the shaft are lined with concrete slabs about 3ft. square, each weighing 7¼ cwt., and twelve of them going to form a ring. An unfortunate accident occurred on the work last week, when some of the slabs fell, killing one workman and injuring six others.

An East Yorkshire Bridge Scheme.

Whether any early progress will be made with the schemes for reclaiming land at Spurn Point, or for bridging or tunnelling the Humber, remains to be seen, but there does seem a prospect of something being done in another important matter in which Hull and East Yorkshire generally are interested, namely, the construction of a bridge over the Ouse at Boothferry, to connect the East and West Ridings. The estimated cost of the bridge, with a 100ft. opening span, and its approaches, is £100,000. Of this, the Ministry of Transport is willing to provide half, and it is suggested that the other half should be allocated among the local authorities, as follows:—West Riding County Council, £25,000; East Riding County Council, £5000; the Borough of Hull, £10,000; Goole, £5000; and Doncaster, £5000. The Works Committee of the Hull Corporation has approved the scheme and the proposed allocation as far as it affects that city, provided a loan sanction for the amount can be obtained. In connection with the building of the bridge there is also a scheme for constructing about 15 miles of new road between Melton and Selby—mostly between Elloughton and Booth Ferry—at an estimated cost of from £250,000 to £300,000.

Some Local Undertakings.

In connection with the Birmingham gasworks scheme, on which it is proposed to spend some £400,000, Harold Arnold and Sons, of Doncaster, have secured a contract for the huge tanks in which the new gasometers will be suspended. The excavations will take many months to complete, and will absorb a large amount of unskilled labour. The construction of the gas-producing plant, to be arranged in the near future, will give much employment in the engineering trades. The contract for the steel work for the new Central Automatic Telephone Exchange at Sheffield has been placed with Lambourne and Co., Limited, of Manchester. Sheffield is somewhat disappointed that the work has not been given to a local firm, but the city will benefit to some extent, as it will be necessary to employ local labour to assist. The Chesterfield Rural District Council has put into operation water and sewerage schemes which will provide work for 220 men for periods varying from four to seven months. The water scheme is estimated to cost £30,000, and comprises the laying of pipe lines from Crow Hole to Steveley and from Barbrook to Stubley. The sewerage schemes, one for Killamarsh and another for Spinkhill and Renishaw, are to cost about £11,000.

NORTH OF ENGLAND.

(*From our own Correspondent.*)

Crisis in Cleveland Ironstone Industry.

A CRISIS has now been reached in the Cleveland ironstone mining industry as a result of the mineowners pressing for longer working hours, and everything depends upon the attitude of the men towards the employers' proposal within the next month as to the future prosperity of the industry. As already intimated in my letter last week joint meetings between the representatives of the mineowners and of the miners have failed to bring about tangible results, and statements have now been issued by both sides dealing with the problem, and from the employers' point of view the likely effect of the men's refusal to accept longer hours is boldly stated. The mineowners proposal is a return to the hours which were prevalent prior to the passing of the Coal Mines Act of 1919, and which were made applicable to the Cleveland mines and not to men engaged in the same kind of mining in other parts of the country, making an extra half an hour on five days per week, Saturday time remaining as at present. In return for the extra hours the employers offer certain increases in the wages of the lower paid adult workers, from a 1d. to 4d. on the base rates. The owners point out that the cost of winning stone is prohibitive, and to-day only half of the mines are working. In the matter of working hours, Cleveland is carrying a burden which has become a serious factor in competing with ores from abroad and even with ores from other parts of the country.

The Men's View.

The views of the men's executive are given in an official statement which has been sent out to the lodges in the district, and mention is made that certain counter proposals have been made to the employers in respect of the base rates and suggesting a new sliding scale with the object of getting one which would give the men a substantial increase above the old scale rate. "The employers," it is added, "are prepared to favourably consider these matters if we can come to terms with regard to hours, and having regard to the fact that all ironstone workers in this country are working eight hours per day or longer, coupled with the circumstances which have surrounded our people for the last two years, the Executive Committee urges the men to very seriously consider the matter before coming to a definite decision." The decision of the men is to be taken by ballot.

Cleveland Iron Trade.

An acute shortage of the better qualities is still the dominating feature of the Cleveland iron trade, and though many inquiries are current the position is such that they cannot be entertained for prompt delivery. To meet the existing shortage of iron, producers would be only too willing to start more blast-furnaces, but the risk of not obtaining a sufficiency of fuel is a real one, while it is difficult to foretell what level prices of coke will ultimately reach. Still it is satisfactory to note that four additional furnaces are being put into blast, though one producing hematite is to be damped down. When these changes are made there will be twelve blast-furnaces producing Cleveland iron on the North-East Coast, fifteen on hematite, and thirteen on basic and other kinds of iron, a total of forty, as compared with thirty-seven at the beginning of the year. For prompt supplies of No. 3 Cleveland G.M.B. 105s. per ton has been paid, and that is now the forward quotation. No. 1 is unobtainable, but it is suggested that 7s. 6d. premium would be paid. Siliceous iron is more plentiful and can be bought round about 105s.; whilst No. 4 foundry is also on offer, both for prompt or forward delivery at 100s. Most of the No. 4 forge has been bought up, but a little might be purchased at 90s. per ton, but there is no mottled or white.

Hematite Pig Iron.

Hematite pig iron has also been sold in large quantities, and promises to become as scarce as foundry iron. The market has assumed a firmer tone, and 100s. per ton is now generally quoted for mixed numbers, though possibly a little less might be accepted.

Iron-making Materials.

The foreign ore trade is quiet, but there is no weakness on the part of sellers, and 24s. per ton is now the general c.i.f. quotation for best Rubio ore. The export demand for coke is phenomenal, and it is extremely difficult to secure supplies outside those contracted for. Home prices have little relationship at present to export prices, but coke makers have so little to sell that they only seem willing to consider the renewal of old contracts with the ironmasters. In such cases 32s. 6d. per ton delivered at the works is an absolute minimum price for good medium furnace qualities, and even then sellers will not commit themselves very far ahead.

Manufactured Iron and Steel.

Much greater activity is reported in the manufactured iron and steel trade, and works have more orders on hand than for a considerable time past. A large number of rail orders has been booked for the Crown Colonies and the Far East, as well as for home railways, but the most active branch of the trade at the moment is the market for shipbuilding material. The aggregate amount of new tonnage ordered is now considerable, and shipbuilding material is being ordered in fair quantities. As costs of production are rising there are fewer sellers who are prepared to cut prices which was the case a few weeks ago.

The Coal Trade.

The Northern coal trade is still in a state of boom, and the tendency of the market is definitely and progressively on the advance. At the moment supplies are almost exhausted, and unless the output at the pits can be greatly increased, the buying for a while will be exceedingly curtailed so far as doing business direct with the collieries is concerned, and any trade will be mostly done through merchants. A good deal of best quality coal has been sold to Germany owing to the occupation of the Rhur by the French, but it is generally recognised that this is only a temporary phase in the situation. So far from it producing a boom in the industry, its effect in future weeks may be precisely the opposite and will create difficulties which at present are not fully appreciated. It is quite certain that the extra demand from Germany cannot last more than a few weeks, and colliery owners are quite prepared for that eventuality. Apart, however, from the German demand there is a much more steady feeling in the trade, and inquiries from other countries and contracts actually made cover a considerable part of 1923. Best steams and gas coals are keenly sought after, and a gratifying feature is the increasing inquiry for seasonal coal, such as nuts and peas. Stocks of these coals are now gradually being reduced, whereas a week or two ago they were a difficulty with colliery owners. There is a particularly brisk demand for gas coal, both from France and other countries, and prices are advancing. Very large bookings have taken place for 1923, and some of the collieries are reported to be fully sold for more than two months ahead. There is, in fact, practically no free coal for the month of February obtainable, and altogether the prospects are remarkably good. The demand for the inland market shows a distinct improvement. The iron and steel works are now taking much larger supplies of coal and coke. In Northumberland steams the possibilities are limited, but prices are rigid on the basis of quite 27s. per ton f.o.b. for best brands, and business has been done at that figure for delivery up to the end of December next. Second screened steams are also favourably placed, while steam smalls of any kind are unobtainable and are almost at famine prices. All grades of gas and coking are heavily booked up by the collieries, and in second hands are at top figures, which applies almost to the same degree in the case of bunkers. Coke prices are advanced for every make.

SCOTLAND.

(From our own Correspondent.)

Steady Improvement.

The industrial outlook continues to improve. The process is slow but steady, and producers are fairly optimistic with regard to future proceedings. A firmer note has already been struck in certain markets, occasioned partly by the increased cost of raw material. The situation on the Continent has, so far, proved of some benefit to local industries. Not only has business been diverted to home works, but orders have also been placed on French and German account. This, coupled with brisker home conditions, has created a state of affairs that makers will not be slow to take advantage of.

The Higher Prices Menace.

A great deal has been heard of unremunerative prices, and it would appear as though the opportunity has arisen to increase quotations. It is hoped, however, that producers will keep any rise in prices within reasonable bounds in view of the turn of the tide in home conditions. A rapid rise would soon put an end to developments here, and might possibly result in wholesale cancellations of orders placed and under contemplation.

Pig Iron: Increased Consumption.

The home consumption of pig iron has considerably increased of late, especially with regard to hematite. Steel makers are not only covering requirements but are anticipating future needs. The foundry qualities, too, are moving off more freely to local consumers and export inquiries have shown a fair broadening out recently. Good shipments to America have been mentioned.

Steel and Iron.

The steel and iron works are busier. The business placed with consumers is now having effect, and while the turnover may not be increasing as rapidly as expected, the orders booked are considerable. Mills are running now that were idle only a short time ago, while new plant has also been put into operation. The large proportion of the steel business is in light material, and makers would welcome orders for heavy plates. Sections, too, could be busier. Steel sheets are comparatively well placed, and are still making headway. The galvanised varieties are also in an improved position. Steel sheets have been advanced in price, and are now quoted as follows:—Under ¼in. to $^{3}/_{16}$in., £11; under $^{3}/_{16}$in. to ¼in., £11 10s.; under ¼in. to 16 g., £12 5s.; under 16 g. to 20 g., £13; under 20 g. to 24 g., £13 15s.; under 24 g. to 27 g., £14 15s., all per ton. Galvanised sheets are quoted in the neighbourhood of £18 to £18 10s. per ton f.o.b. Heavier bookings are reported from the bar ironworks on both home and export account. Firmer prices are mentioned, but basis quotations are not yet altered. The re-rolled steel branch of this industry is steadily improving. Re-rolled steel bars are quoted £9 5s. home and about £9 per ton for export. The wages in the bar iron trade are to be reduced by 2½ per cent. on basis rates in view of the decrease in the average selling price to £10 16s. 5.67d. per ton.

Dearer Coal.

Business in the Scotch coal trade was comparatively quiet during the greater portion of last week. Inquiries were brisk enough and come from various quarters, but firm orders were small in comparison. Consequently, with exports the chief feature at present, the turnover was restricted. The collieries have fair bookings, and owners are not prepared to transact forward business unless at enhanced prices, while exporters, in view of the fact that the bulk of the inquiries are on German account, are not prepared to commit themselves to any extent. Within the past day or two, however, orders, it is said, amounting to about 30,000 tons have been booked for shipment to Germany at increased prices. It has been said that exporters are quite ready to do business with organisations owned by Stinnes or Thyssen, but are chary of the financial status of other German concerns. Aggregate shipments from Scottish ports last week amounted to 311,226 tons against 273,407 tons in the preceding week and 182,601 tons in the same week last year. The local market for fuel remains dull. Industrial requirements are a trifle larger, but easily disposed of. Washed single nuts, however, are now freely sold. Best qualities of house coal are active, and prices are likely to appreciate.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

Although South Wales has not shared to any material extent in the demand for coals for German account, and to all outward appearances the inquiry has been quiet, the steam coal market has displayed a very firm tone this week, especially as regards small coals. The fact that this is the case shows the strong position of collieries from the point of view of the orders they have on their books. Some of the leading undertakings have very little coal to offer for the next month or so, and it is fortunate that this is so, as with the adverse movement taking place in the foreign exchanges it is inconceivable that fresh business can be very active while such conditions prevail and the political situation on the Continent is so uncertain. Of course, the market does not present an absolutely firm front, as dock conditions do not permit it. While there is as heavy a loading pressure as now exists it must inevitably follow that some collieries will suffer on account of the delay in their tonnage getting into berth. Such delay means that they find it hard to secure a prompt outlet for their coals, notwithstanding that they are fully booked and have the tonnage in dock. Rather than run the risk of having their pits idle for the want of empty wagons, salesmen are still compelled to make sacrifices in price to those buyers who can ship coals immediately, but this is better than incurring the heavy expense of collieries being temporarily idle. The chief demand on the market at the present moment from France and Belgium is for small coals. There is no doubt that these qualities are required for the manufacture to a large extent of patent fuel, thus replacing the fuel made in this district, but which cannot be produced on a competitive basis owing to excessive cost of pitch. The Paris-Orleans Railway is in the market for 80,000 tons of small coals for delivery at various North French and Bay ports over the next two months, and the Belgian State Railways are inquiring for tenders for 56,000 to 80,000 tons of Cardiff smalls, in eight lots of 7000 to 10,000 tons for delivery at the ports of Antwerp, Ghent, or Zeebrugge. The stipulation is made that half the above quantity must be shipped within three weeks of the order being placed and the balance within the following three weeks. The conditions regarding analysis, delivery, &c., are fairly onerous, especially considering the abnormal conditions prevailing at the present time. The Norwegian State Railways are also in the market for 35,000 tons of double-screened best Admiralty large coals, but it is scarcely likely that more than about 10,000 to 12,000 tons of coal will be taken from this district. As regards other contract business, the Mauritius Government has placed an order with a London firm for 30,000 tons of large coal for delivery in about equal monthly quantities after March 15th, the price being between 43s. and 44s. net c.i.f. Mauritius. The order for 35,000 tons of large coal for the Egyptian State Railways has also been placed for Monmouthshire qualities. These coals have to be delivered at Alexandria by March 25th, so that the shippers have not much time to play with. The Norte Railways of Spain are also reported to have bought 20,000 tons of second Admiralty large coals for delivery at Santander, Bilbao, Corunna, Pasajes, Valencia and Tarragona by the end of February.

Dock Delays.

The members of the Joint Committee which has been paying a round of visits to the different ports in this channel to investigate the cause of delays will submit separate reports as to their findings to their respective sides. The employers' representatives will report to the Traders' Committee on Friday next (February 2nd), and the coal trimmers' and tippers' delegates will report to a special South Wales conference to be held at Cardiff on the day previous, and to a national meeting in London on the following day. Last week Mr. Finlay Gibson, the secretary of the South Wales Coalowners' Association, and its transport officer, Mr. Marlow Allen, visited the ports on the Tyne for the purpose of obtaining full information as to the general transport and shipping arrangements there. Their reports will be submitted to the Commercial Committee of the Coalowners' Association. Mr. Gibson, however, has stated that the method of shipment there is totally different to that in operation in South Wales, and the Tyne ports have geographical advantages which the South Wales ports do not possess, as a consequence of which the rate of shipment per hour is greater than in South Wales, but to his mind the result of his visit proves conclusively that extended facilities must be provided at the Bristol Channel ports, not only at the present time, but also to cope with an extension of trade, if South Wales is to hold its position as the premier coal-exporting centre of the world.

Miners' Hours.

One of the questions which has figured prominently lately in this district is that of a reversion to an eight-hour day at the collieries, but it is evident that the miners' leaders intend to offer a strenuous opposition to the proposal. One of the leaders in South Wales has stated that an eight-hour day would entail a loss of wages to the piece workers, and would lead to the dismissal of one-seventh of the day-wage men, as all the repair work would be satisfactorily done in the seven hours in the absence of an increased demand for South Wales coals. According to Mr. W. Johnson, the new President of the South Wales Institute of Engineers, who dealt with the question at the annual meeting of that organisation last Friday, the experience of the operation of the Seven-hour Act was that the industry had been anything but successful or satisfactory either to the owner, workman or consumer. The collier produced anything from 4 cwt. to 10 cwt. per shift less coal than he did under the Eight-hour Act. Placing the average loss of output as the result of the seven-hour day as low as 5 cwt. per collier per day, this would mean that if they reverted to the eight-hour day, the gain in output of the medium-sized colliery would amount to 37,500 tons a year, and they could imagine what that meant when applied to the production of the United Kingdom.

By-product Workers' Wages.

At a meeting of representatives of the Monmouthshire and South Wales Coke Owners and By-product Works Association and representatives of the workmen, agreement was arrived at, on Saturday last, concerning the wages of coke-oven and by-product workmen. The wages of these workmen were reduced by 7½ per cent. in December, 1921, and a further reduction of 10 per cent. in May of last year. The terms of the agreement now reached provide that the owners restore, from February 1st, 5 per cent. of the reduction made in May last, a further 5 per cent. on May 1st, and a further 2½ per cent. on August 1st. The agreement is to operate until September 30th, and is to be subject thereafter to one month's notice by either side on October 1st.

Current Business.

Notwithstanding the rather quiet demand which prevails for large coals, the tone of the market is for the most part firm, except in isolated cases for prompt shipment. Collieries have very good order books, and in view of the fact that demand for coals from abroad may expand they are very cautious regarding future commitments, and decline to sell ahead unless they can get very good prices, such as those now being currently quoted. At the same time it is recognised that the outlook is very obscure as the result of the political conditions abroad. At the moment owners are quoting 29s. to 30s. for best Admiralty large, and 28s. 6d. to 29s. for second qualities. Dry coals are the weakest section in the market on the basis of 27s. 6d. to 28s. for best, and 26s. to 27s. for ordinary descriptions. Monmouthshire coals are very steady and well stemmed, and collieries are asking for 28s. 6d. to 29s. for best Black Veins. The feature of the market is the heavy demand for small coals, and some collieries are firmly quoting 22s. for the best qualities. The patent fuel position is unchanged, and makers are declining to quote for supplies ahead owing to the uncertain outlook regarding pitch. Pit-wood is easy and rules about 26s. to 27s.

Swansea Metal Exchange.

The tin-plate market is firm, and works are well booked up for orders to the end of April. The report is current that a substantial oil plate order has been secured against American competition.

The Institution of Automobile Engineers.—It has been decided that the summer visit of the Institution shall be held in Liverpool, commencing Monday, June 18th. The places to be visited will be almost entirely to works devoted to industries differing from those with which members are brought into contact in their daily work. As far as possible, special attention will be paid to local industries, such as calico printing, cotton spinning, &c. The Daimler Premium of £25, annually awarded for the best paper written by a graduate under certain conditions, has been awarded to Mr. M. Platt, of the London Centre, for his paper on "The Design of Connecting-rods for High-speed Engines." The Graduates' Prize of £5 5s., offered annually by the Institution for the best paper read before any Centre during the session, has been awarded to Mr. H. Briggs for his paper on "Repetition Work in the Engineering Industry," the second prize of £2 2s. going to Mr. L. F. Watson for his paper on "Mechanical Efficiency." The Council of the Society of Motor Manufacturers and Traders has nominated Lieut.-Colonel J. A. Cole and Mr. J. Maughfling as judges for the Utility Prize for the paper read before the Institution in any session which appears to be of the greatest value to the automobile industry.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	22/6
(1) Spanish	21/6
(1) N. African	21/6
N.E. COAST—	
Native	—
Foreign (c.i.f.)	21/

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 7 6	—
No. 1 Foundry	5 3 0	—
No. 3 Foundry	4 18 0	—
N.E. COAST—		
Hematite Mixed Nos.	5 0 0	5 0 0
No. 1	5 1 0	5 1 0
Cleveland—		
No. 1	5 10 0	5 10 0
Silicious Iron	5 5 0	5 5 0
No. 3 G.M.B.	5 5 0	5 5 0
No. 4 Foundry	5 0 0	5 0 0
No. 4 Forge	4 10 0	4 10 0
Mottled	4 5 0	4 5 0
White	4 5 0	4 5 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge	4 0 0	—
,, ,, Foundry	4 10 0	—
(3) Northampton—		
Foundry No. 3	4 5 0 to 4 7 6	
,, Forge	3 16 0	—
(3) Derbyshire—		
No. 3 Foundry	4 7 0 to 4 10 0	
Forge	4 5 0	—
(3) Lincolnshire—		
Basic	4 10 0	—
Foundry	4 5 0	—
Forge	4 2 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 12 6	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 0 0	10 10 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	11 0 0	—
Teas	10 0 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. YORKS.—		
Crown Bars	11 10 0 to 12 0 0	
Best ,,	12 10 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	10 15 0 to 11 5 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	10 0 0 to 10 5 0	
Gas Tube Strip	10 15 0 to 11 0 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	12 0 0	—
Ship Plates ¾in. and up	9 0 0	—
Sections	8 15 0	—
Steel Sheets ¼in. to ½in.	11 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 15 0

STEEL (continued)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	9 10 0	—
Angles	9 0 0	—
Boiler Plates	13 0 0	—
Joists	9 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0 to 14 0 0	
Channels	9 5 0	—
Hard Billets	8 15 0	—
Soft Billets	8 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 15 0	—
Light ,,	9 15 0 to 10 5 0	
Billets	8 15 0	—
MANCHESTER—		
Bars (Round)	9 0 0 to 9 10 0	
,, (others)	9 10 0 to 10 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	9 0 0 to 10 0	
,, (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	11 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	9 5 0	—
Intermediate Basic	9 0 0	—
Soft Basic	8 0 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	10 0 0 to 10 10 0	
MIDLANDS—		
Small Rolled Bars	9 10 0 to 9 15 0	
Billets and Sheet-bars	7 17 6 to 8 5 0	
Gas Tube Strip	10 5 0 to 10 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	18 5 0 to 18 10 0	
Angles	9 5 0 to 9 10 0	
Joists	9 0 0 to 9 5 0	
Tees	10 5 0 to 10 10 0	
Bridge and Tank Plates	9 15 0 to 9 17 6	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	21 - to 21/6
Block Tin (cash)	188 5 0
,, (three months)	187 10 0
Copper (cash)	65 17 6
,, (three months)	66 10 0
Spanish Lead (cash)	28 17 6
,, (three months)	28 12 6
Spelter (cash)	37 5 0
,, (three months)	35 10 0
MANCHESTER—	
Copper, Best Selected Ingots	71 10 0
,, Electrolytic	73 0 0
,, Strong Sheets	96 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11½
,, Condenser	0 1 1½
Lead, English	20 0 0
,, Foreign	29 0 0

FERRO ALLOYS.

(All prices now nominal.)

Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/6 per lb.	
	Per Ton.	Per Unit
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23	10/6
,, 6 p.c. to 8 p.c. ,,	£21 0 0	8/-
,, 8 p.c. to 10 p.c. ,,	£20 0 0	8/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£54 0 0	20/-
,, ,, 1 p.c. ,,	£84 0 0	22/6
,, ,, 0·75 p.c. carbon	£72 0 0	25/-
,, carbon free	1/7 per lb.	
Metallic Chromium	4/9 per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£11 2 6 scale 5/- per unit	
,, ,, 75 p.c.	19 10 0 scale 6/- per unit	
,, Vanadium	17/- per lb.	
,, Molybdenum	9/6 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£130	
Cobalt	11/- per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

	Export.
SCOTLAND.	
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	23/-
,, ,, Ell	25/6
,, ,, Splint	25/- to 26/6
,, ,, Trebles	23/3
,, ,, Doubles	21/6
,, ,, Singles	18/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	23/-
,, ,, Splint	25/-
,, ,, Trebles	23/3
FIFESHIRE—	
(f.o.b. Mothill or Burntisland)—Steam	25/- to 26/6
Screened Navigation	30/-
Trebles	23/6
Doubles	22/-
Singles	19/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	25/-
Secondary Steam	23/9
Trebles	23/9
Doubles	22/6
Singles	19/6
ENGLAND.	
(8) N.W. COAST—	
Steams	29/-
Household	46/8 to 57/6
Coke	38/-
NORTHUMBERLAND—	
Best Steams	30/-
Second Steams	26/6
Steam Smalls	17/6 to 20/-
Unscreened	20/6
Household	25/- to 28/-
DURHAM—	
Best Gas	27/6
Second	26/-
Household	25/- to 28/-
Foundry Coke	45/- to 50/-
SHEFFIELD—	**INLAND.**
Best Hand-picked Branch	32/6 to 34/6 —
Barnsley Best Silkstone	28/- to 30/- —
Derbyshire Best Brights	24/- to 26/- —
,, ,, House	21/6 to 22/6 —
,, ,, Large Nuts	19/6 to 22/6 —
,, ,, Small ,,	15/- to 16/6 —
Yorkshire Hards	20/- to 21/- —
Derbyshire ,,	19/- to 20/6 —
Rough Slacks	9/- to 11/- —
Nutty ,,	7/9 to 9/9 —
Smalls	3 - to 5/- —
Blast Furnace Coke (inland and Export)	22/- to 30/-
CARDIFF—	**(9) SOUTH WALES.**
Steam Coals:	
Best Smokeless Large	29 6 to 30,-
Second ,, ,,	28/- to 29/-
Best Dry Large	28/- to 28,6
Ordinary Dry Large	26,6 to 27/6
Best Black Vein Large	28/- to 29/-
Western Valley ,,	28/- to 28/6
Best Eastern Valley Large	27/6 to 28/-
Ordinary ,, ,,	25/6 to 27/-
Best Steam Smalls	21/- to 23/-
Ordinary ,,	17/- to 19/-
Washed Nuts	25/- to 32,6
No. 3 Rhondda Large	30/- to 31/-
,, ,, Smalls	19/- to 21/-
No. 2 ,, Large	26/- to 27/-
,, ,, Through	21/6 to 23/-
,, ,, Smalls	16/- to 17/-
Coke (export)	40/- to 45,-
Patent Fuel	—
Pitwood (ex ship)	26/- to 27/-
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	30/- to 32,6
Red Vein	29/- to 30/-
Machine-made Cobbles	52/6 to 55/-
Nuts	52/6 to 55/-
Beans	42/6 to 45/-
Peas	21/- to 23/-
Breaker Duff	11/- to 12/-
Rubbly Culm	14/- to 14/6
Steam Coals:	
Large	26/- to 27/-
Seconds	23/- to 25/-
Smalls	13/6 to 15/-
Cargo Through	18/- to 22,6

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Coke Supplies.

THE precarious situation in which the Lorraine blast-furnace proprietors found themselves as a result of the irregular supplies of coke has been revealed by the damping down of a large number of furnaces on account of the almost total cessation of coke deliveries from the Ruhr. There has been a good deal of disappointment over the absence of positive results from the Ruhr occupation, but it is now recognised that it was imprudent to count upon immediate supplies of coke when there was the possibility of an organised resistance on the part of oven owners and coal producers, and there is little hope of matters being adjusted until the French Government has had time to organise the control of the ovens and collieries, in the event, that is, of its succeeding at all. As the Germans refuse to work, arrangements are being made to draft men into the Ruhr, and in the event of an insufficient number being available in this country it is expected that as many as may be required will be procurable from Poland and elsewhere. It is hoped that when the Germans find that they are being replaced they will be prepared to resume work, especially in view of the advantages that will be offered them ; but as this will probably take a considerable time, the situation of firms depending upon supplies of raw material from the Ruhr will be extremely serious. If the present state of things should continue there will be a dearth of pig iron that must restrict production in all branches of the metallurgical trades and bring about a further advance in prices. Already consumers are withholding orders in the belief that the present period of restricted production and high prices will be followed by a big drop in values as soon as affairs in the Ruhr are properly organised ; but there is a general feeling of uncertainty arising from the fact that it is impossible to fix anything like an approximate date when the Ruhr will be supplying French consumers with coal and coke, while the manner in which the German resistance will be continued to prevent the French from carrying out their tasks is still an unknown factor. The only certain fact is that the French are determined to isolate the Ruhr from the rest of Germany, and organise it for the benefit of the home industries until they have obtained complete satisfaction.

The Naval Programme.

Some complaint is being made of the delay in giving out orders to private shipyards in connection with the naval programme, comprising the construction of three cruisers of 8000 tons, six destroyers of 2400 tons, twelve torpedo boats of 1460 tons, and six submarines of 600 tons, together with the transformation of the Béarn into a seaplane carrier. Private shipyards will build four destroyers and all the torpedo boats and submarines, but while work is being carried on actively at the arsenals, no contracts have yet been distributed amongst private builders, and it is complained that, apart from the utility of putting all the work in hand simultaneously, it is unfair to delay giving employment to men in the shipyards while those in the arsenals are specially favoured. The official explanation is that the prices submitted by private shipbuilders are so much above the estimated costs that the Ministry of Marine cannot accept them without risk of incurring the displeasure of Parliament. At the same time no one knows what the ships are costing in the arsenals.

The Rove Tunnel.

The work on the tunnel, which has been driven through the Nerthe range for the canal from Marseilles to the Rhone, is so far advanced that it is expected to be entirely completed next year, and will be put into service in 1925. Of the two and a-half million cubic metres of rock that have to be excavated, or more than twice as much as for the two Simplon tunnels, there remain only half a million cubic metres to be removed. The arch is entirely completed, and work is now being continued on the canal itself. In two years' time Marseilles will be in communication not only with the Rhone at Arles but also with the Etang de Berre, which is to become an extension of the port of Marseilles, providing practically unlimited accommodation for cargo boats and for the traffic passing through the future Rhone canal with the whole of western and central Europe. The construction of the Rove tunnel, owing to the delays caused by the war, will have occupied close upon fifteen years. The greater part of the cost is being borne by the Marseilles Chamber of Commerce.

Foreign Trade.

The returns of foreign trade in 1922 show a general improvement as compared with the figures for the preceding year, the only falling off being in the values of manufactured goods, although there was an increase in quantities, and it is to be remarked also that there was a steady monthly progression during the second half of the year, thereby indicating that a real improvement had set in. The values of imports were based upon the verified declarations of importers, while the exports were arbitrarily valued by Customs. The total imports were estimated at 23,900 million francs, representing an increase on the year of 1832 million francs. Of this total raw material accounted for 14,048 millions and manufactured goods 4052 millions. The exports, valued at 20,642 million francs, were 869 million francs above those of the preceding year. Manufactured goods were responsible for 11,860 million francs, and raw material 5443 million francs. The returns giving the weights showed that the imports totalled 51,366,706 tons, an increase on 1921 of 11,304,604 tons. The quantity of raw material imported was 44,606,348 tons, and of manufactured goods 1,696,145 tons. The exports amounted to 22,615,688 tons, an increase of 6,580,667 tons, and included raw material, 19,144,962 tons ; and manufactured goods, 2,494,542 tons. So far as quantities are concerned more business was done last year than before the war, although this must be attributed in a large measure to the considerable imports of coal and raw material, and to the heavier consignments abroad of iron ore, crude metal, and partly manufactured iron and steel.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

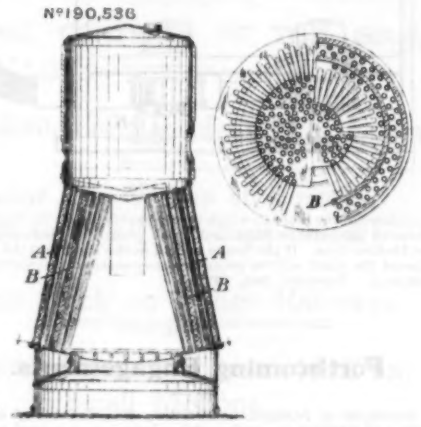
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application ; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

190,536. September 22nd, 1921.—VERTICAL BOILERS, L. H. Hindley, 11, Queen Victoria-street, London, E.C. 4.

THE inventor claims that the arrangement of water tubes he uses not only improves the passage for the furnace gases between them, but also helps to support the bottom of the top header against internal pressure. The outer tubes A A are raked in the

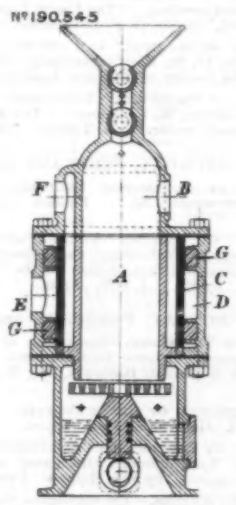


usual manner for this type of boiler, but those inside the baffle B are set at different angles so that they occupy almost the whole remaining area of the tube plate. The furnace gases circulate between the baffle and the outer casing and escape by a chimney arranged in any convenient place.—*December 22nd*, 1922.

GAS PRODUCERS.

190,545. September 24th, 1921.—GAS GENERATORS, F. Umpleby, 24, Tufton-street, Silsden, near Keighley, and H. Powers, 6, Westfield-terrace, Park-road, South Farnborough.

In this specification it is proposed to gasify carbonaceous material by means of the intense radiant heat produced by surface combustion. The retort A is fed with fuel at the top, and has a grate at the bottom that can be vibrated with a cam gear. The gas outlet is at B. The retort is surrounded by a porous refractory wall C behind which there is an annular chamber D. A combustible mixture of gas and air is supplied at E, and burns at the surface of the porous wall C, thus heating the retort by

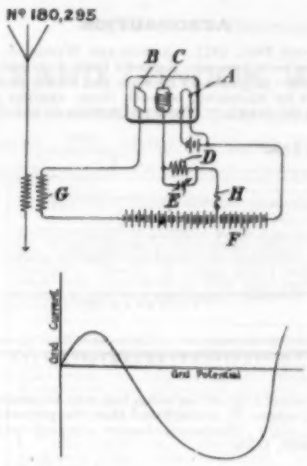


radiation. The products of combustion escape at F. The plugs G G are intended to keep the annular chamber cool by conduction. It is suggested that a variety of materials may be gasified, and that the addition of calcareous material is advantageous, as it has a catalytic influence on the gas reactions, whilst the carbon dioxide driven off from it may be reduced to carbon monoxide in contact with the hot carbon. Suggestions are also made for balancing the gas pressures inside and outside the retort in order to reduce the stresses in its fabric.—*December 27th*, 1922.

TELEGRAPHS AND TELEPHONES.

180,295. May 18th, 1921.—IMPROVEMENTS IN AND RELATING TO SYSTEMS FOR PRODUCING OSCILLATING CURRENTS, The British Thomson-Houston Company, Limited, of 83, Cannon-street, E.C.

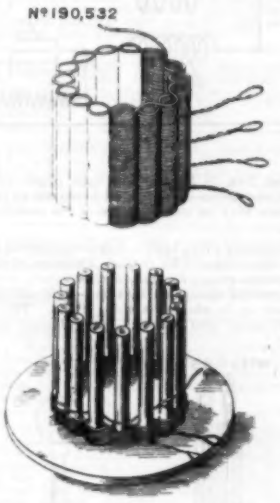
The electron emitting cathode, the anode and the grid are shown at A, B, and C respectively. A circuit between the cathode and grid includes the inductance D and capacity E by means of which the circuit may be tuned to the frequency of the oscillations which it is desired to produce. The circuit between the cathode and anode includes a source of potential such as a battery F and a primary winding G of a transformer, the secondary winding of which is included in the working circuit. The connection from the grid to the cathode may be made by means of a variable connection H to a point on the battery F so as to obtain a suitable potential for producing oscillations between the cathode and grid by means of the negative resistance of the circuit as shown by the curve. The only essential condition for continuous operation of the system



is that the potential of the source F shall be high enough, so that the potential of the anode will be sufficiently higher than that of the grid to carry off the electrons emitted from the grid C.—*December 28th*, 1922.

190,532. September 21st, 1921.—IMPROVEMENTS IN AND RELATING TO INDUCTANCE COILS, John Pain Prangnell, The Chestnuts, Erith-road, Bexley Heath, Kent.

This coil consists of copper wire wound cylindrically and interwoven with temporary wooden uprights which give the coil a basket like appearance. Such a coil has a low self-capacity and a high efficiency. The coil is wound on a frame comprising a number of symmetrically arranged rods, and the wire is zig-

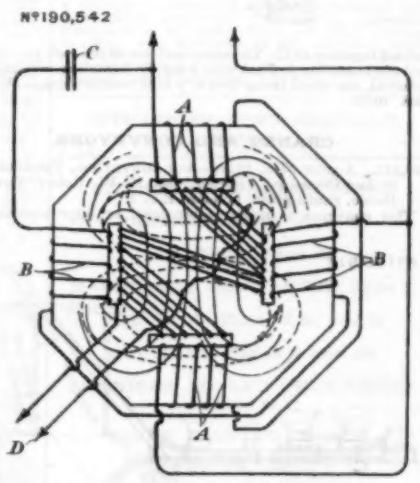


zagged in and out around the rods in a similar manner to the weaving of the sides of a basket. Tappings are taken from various positions in the winding of the coil and are connected with the stops of a selecting switch by which more or less of the inductance can be introduced into the circuit in which the coil is required.—*December 21st*, 1922.

TRANSFORMERS AND CONVERTERS.

190,542. September 23rd, 1921.—IMPROVEMENTS IN ELECTRIC TRANSFORMERS, The British Power Railway Signal Company, Limited, of 3a, Dean's-yard, Westminster, S.W. 1, Henry Tinsley, and Douglas Crisp Gall, of Werndee Hall, Stanger-road, London, S.E. 25.

The transformer described in this specification enables a current with a constant alternating potential to be transformed



into a constant current. The transformer, which is of the two-phase type, is particularly suitable for electric railway signalling systems. The two primary windings A of one phase are connected in series, and produce a flux as shown by the dotted lines, whilst

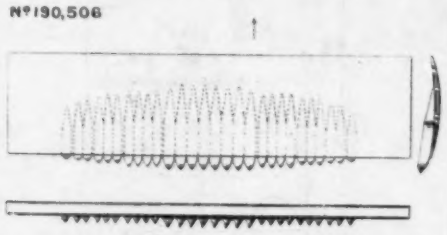
the primary windings B produce a flux as shown by the full lines. These windings are also connected in series and a condenser is connected as shown at C. The constant current is drawn from the secondary terminals D.—*December 27th*, 1922.

AERONAUTICS.

190,506. June 28th, 1921.—AEROPLANE WINGS, J. C. Barker, 21, Gloucester-crescent, Regent's Park, London, N.W. 1.

The inventor proposes to increase the lifting power of aeroplane wings by attaching, beneath them, angular projections, as shown in the drawing. These projections do not extend to the

Nº 190,506



front, or leading edge of the wing, but may be prolonged behind the trailing edge. It is suggested that the projections may be formed by light aluminium frames covered with fabric.—*December 28th*, 1922.

MEASURING AND TESTING INSTRUMENTS.

190,613. November 21st, 1922.—IMPROVEMENTS RELATING TO INSTRUMENTS FOR MEASURING OR INDICATING THE WATTLESS COMPONENTS OF ALTERNATING CURRENT, Chamberlain and Hookham, Limited, and Samuel James, all of 4, New Bartholomew-street, Birmingham.

The current coil of the instrument is shown at A, and the voltage coil at B. In series with the latter is a condenser C for

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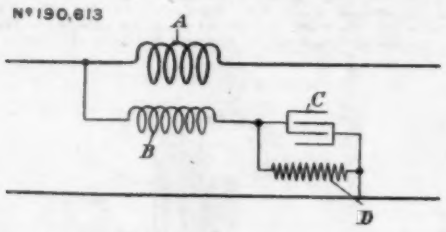

enabling the flux to be brought into phase with the applied voltage. A resistance is connected as shown at D. Alternatively an inductance may be used in place of the resistance.—*December 28th*, 1922.

190,657. January 27th, 1922.—IMPROVEMENTS IN AND RELATING TO PYROMETERS, *The British Thomson-Houston Company*, 83, *Cannon-street, London, E.C.* 4.

The pyrometer described in this specification is suitable for temperatures up to about 2000 deg. Cent. The pyrometer consists of a tungsten rod A and a molybdenum rod B, which are

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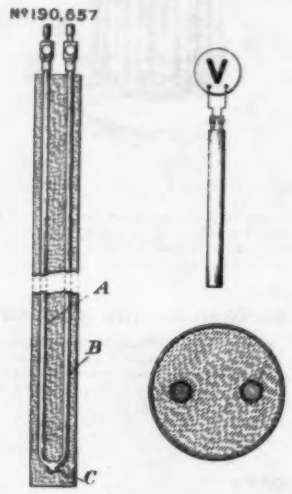


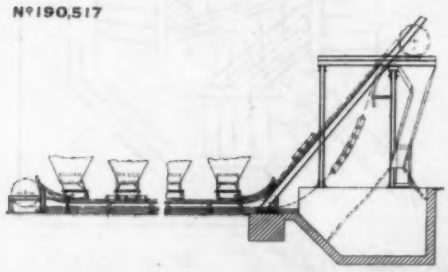
welded together at C. The outer surfaces of the rods are oxidised and the container is filled with a highly refractory non-oxidising material, the whole being fired at a high temperature.—*December 28th*, 1922.

CRANES AND CONVEYORS.

190,517. August 24th, 1921.—ASH CONVEYORS, The Underfeed Stoker Company, Limited, and E. W. Robey, Coventry House, South-place, London, E.C. 2.

This conveyor is made water-tight, or approximately so,

Nº 190,517



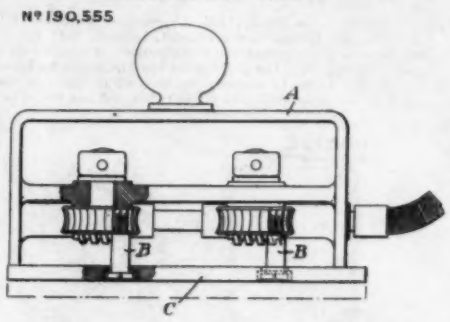
either by connecting together the individual metal buckets by means of flexible waterproof gussets, or by making the conveyor of a continuous flexible band. The conveyor passes under the ashpit openings, and is sloped upwards at each end. The result is that a closed trough is formed that may be filled with water in order to seal the ashpit openings. The ashes are carried along by the conveyor and discharged in the usual manner, but the water remains behind in the trough.—*December 27th*, 1922.

MACHINE TOOLS AND SHOP APPLIANCES.

190,555. September 28th, 1922.—POLISHING MACHINES, The Selson Engineering Company, Limited, 85, Queen Victoria-street, London, E.C. 4, and J. C. Walker, 37, Clephane-road, London, N. 1.

This little device is intended for grinding or polishing surfaces. It comprises a frame A in which there are mounted two worm gears, driven through a flexible shaft from any convenient source of power. The worm wheels have crank pins B B that

Nº 190,555



pass through the plate C, which is free to slide under the frame A. Abrasive material is fixed under the plate C as indicated by the broken lines. If the frame is held in the hand and the shaft rotated the plate will be given a rotary motion for grinding or polishing.—*December 28th*, 1922.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "Fact and Phantasy in Industrial Science," by Mr. C. F. Cross. 9 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—Visit to the works of Gresham and Craven, Ordsall-lane, Salford. 3 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—College of Technology, Manchester. Paper, "The Theory and Practice of Steam Jet Instruments," by Mr. J. N. Gresham. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette, "Ventilation and Lighting of Factories" (slides), by Mr. P. J. Waldram. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, S.W. 1. Informal meeting. "The Use of Light Alloys in Place of Iron and Steel," by Mr. A. E. L. Chorlton. 7 p.m.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—The Textile Institute, 16, St. Mary's Parsonage, Manchester. Joint meeting with the Society of Chemical Industry. 7 p.m.

INSTITUTION OF PRODUCTION ENGINEERS.—The Engineers' Club, Coventry-street, W. 1. Paper: "The Moving Picture in Industry" (slides), by Mr. G. E. Turner. 7.30 p.m.

SATURDAY, FEBRUARY 3RD.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Florence Restaurant, Rupert-street, W. 1. London Graduates' dinner. 7.15 p.m.

INSTITUTION OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—College of Technology, Sackville-street, Manchester. Lecture: "A Practical Cost System for the Small or Medium-sized Foundry," by Mr. P. I. Hill. 4 p.m.

MONDAY, FEBRUARY 5TH.

INSTITUTE OF TRANSPORT.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Paper, "Wagon Stock on British Railways," by Mr. H. N. Gresley. 5.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. General meeting. 5 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The College, Loughborough. Loughborough Graduates' meeting. Paper: "Semi-Diesel Engines," by Miss Holmes. 7 p.m.

SOCIETY OF ENGINEERS.—The Geological Society, Burlington House, Piccadilly, W. 1. Paper: "Practical Notes on Inspection," by Mr. A. Collis-Brown. 5.30 p.m.

BRADFORD ENGINEERING SOCIETY.—The Technical College, Bradford. Lecture: "Stainless Steel and its Engineering Applications," by Mr. H. Brearley. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. Cantor Lecture, "The Vulcanisation of Rubber," by Mr. H. P. Stevens. 8 p.m.

TUESDAY, FEBRUARY 6TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Hotel Cecil, Strand, W.C. 2. Annual dinner. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Paper: "Wind Pressures and Stresses Caused by the Wind on Bridges," by Mr. D. H. Remfry. 6 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Coventry Graduates' meeting. Paper: "The Effect of Wind Speed and Direction upon Engine Cooling," by Mr. G. V. Brooke. 7.45 p.m.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Chamber of Commerce, New-street, Birmingham. Discussion: "The Casting of Non-ferrous Metals and Alloys." 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—The Metropole, King-street, Leeds. Paper: "The Maintenance of Voltage on a Direct-current Distribution System by Means of an Automatic Sub-station," by Mr. P. J. Robinson. 7 p.m.

INSTITUTION OF BRITISH FOUNDRYMEN: BURNLEY SECTION—College of Technology, Ormerod-road, Burnley. Demonstration: "Plaster Pattern Making," by Mr. R. Christie. 7.15 p.m.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Literary and Philosophical Society, 36, George-street, Manchester. Joint meeting with the Literary and Philosophical Society. 5.30 p.m.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Holborn Restaurant, W.C. 2. Annual General Meeting. Paper: "Theory of Combustion of Gaseous and Liquid Fuels," by Professor W. E. Garner. 2.30 p.m.

WEDNESDAY, FEBRUARY 7TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Electrical Resistance Furnaces and their Uses," by Mr. C. R. Darling. 8 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—White Horse Hotel, Congreve-street, Birmingham. Birmingham Graduates' dinner. 7.30 p.m.

INSTITUTION OF SANITARY ENGINEERS.—Caxton Hall, Westminster, S.W. 1. Paper: "National Water Resources and their Allocation," by Mr. P. Griffith. 8 p.m.

NEWCOMEN SOCIETY.—The Alpine Club, 23, Savile-row W. 1. (nearest Tube Station, Dover-street). Paper: "East Indian Cotton Prints and Paintings of the Seventeenth and Eighteenth Centuries," by Mr. G. P. Baker. 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. 2. Wireless Section Meeting. "The Measurement of the Electric Intensity of Received Radio Signals," by Mr. J. Hollingworth. 6 p.m.

THURSDAY, FEBRUARY 8TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Institute of Marine Engineers, 85–88, The Minories, Tower Hill, E. 1. Paper: "The Investigation of the Constitution of Alloys," by Miss M. L. V. Gayler. 8 p.m.

OPTICAL SOCIETY.—Imperial College, Imperial Institute-road, South Kensington, S.W. 7. Annual General Meeting. Presidential address: "Large Telescopes," by Sir Frank Dyson. 7.30 p.m.

FRIDAY, FEBRUARY 9TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, S.W. 1. Adjourned discussion on symposium of papers on "Indicators." 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecture, "The Effect of Temperature on the Properties of Engineering Materials," by Professor F. C. Lea. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse: "Rothamsted and Agricultural Science," by Sir John Russell. 9 p.m.

WEST BROMWICH ENGINEERING SOCIETY.—Technical School, West Bromwich. Paper: "Wireless Telephony," by Mr. H. Littley. 7.30 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Mappin Hall of the University, St. George's-square, Sheffield. Conjoint meeting with the Faraday Society. Symposium on "Stainless and Non-corrodible Alloys." 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—The City Art Gallery, Mosley-street, Manchester. Conversazione. 7.30 p.m.

SATURDAY, FEBRUARY 10TH.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to the Greenford factory of J. Lyons and Co., Limited.

TUESDAY, FEBRUARY 13TH.

INSTITUTE OF MARINE ENGINEERS.—85–88, The Minories, Tower-hill, E. 1. "Internal Combustion and Economy," by Mr. T. D. Madsen. 6.30 p.m.

INSTITUTE OF INDUSTRIAL ADMINISTRATION.—London School of Economics, Houghton-street, Aldwych, W.C. 2. Lecture: "Practical Hints on Buying and Selling," by Mr. F. Mott. 8 p.m.

INSTITUTE OF TRANSPORT.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Metropolitan Graduate and Student Society Meeting. Paper: "Railway Rules and Regulations," by Mr. B. Wagenrieder. 6 p.m.

WEDNESDAY, FEBRUARY 14TH.

ASSOCIATION OF ENGINEERS-IN-CHARGE.—St. Bride's Institute, Bride-lane, Fleet-street, E.C. 4. Paper, "Hydraulic and Electric Lifts," by Mr. C. H. J. Day. 7.30 p.m.

INSTITUTE OF STRUCTURAL ENGINEERS: LANCASHIRE AND CHESHIRE BRANCH.—Engineering Laboratory, Victoria University, Coupland-street, Manchester. Discussion on Mr. A. S. Spencer's paper: "An Investigation on the Theory of Flexural Resistance." 7.15 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Armstrong College, Newcastle-upon-Tyne. Discussion. 7.30 p.m.

THURSDAY, FEBRUARY 15TH.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. 2. "The Practical Aspects of the Seaplane," by Wing-Commander T. R. Cave-Brown-Cave. 5.30 p.m.

FRIDAY, FEBRUARY 16TH.

INSTITUTION OF ENGINEERING INSPECTION.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Paper, "Chemical Inspection as it Is and as it Should Be," by Mr. H. T. F. Rhodes. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette: "Notes on Some Insulating Materials," by Mr. T. L. Allison. 7.30 p.m.

SATURDAY, FEBRUARY 17TH.

WEST YORKSHIRE METALLURGICAL SOCIETY.—Technical College, Bradford. "Cast Iron," by Mr. E. Adamson. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the buildings in course of construction at Wembley for the British Empire Exhibition. 2 p.m.

TUESDAY, FEBRUARY 20TH.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—The Metropole, King-street, Leeds. Paper: "Some Problems in High-speed Alternators and their Solution," by Mr. J. Rosen. 7 p.m.

INSTITUTE OF TRANSPORT.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Graduates' and Students' lecture: "Modernisation of Passenger Railway Stations," by Messrs. F. Bushrod and J. F. S. Tyler. 5.30 p.m.

THURSDAY, FEBRUARY 22ND.

INSTITUTION OF STRUCTURAL ENGINEERS.—Denison House, 296, Vauxhall Bridge-road, S.W. 1. Paper: "Shear Resistance," by Mr. E. Godfrey; will be read by Mr. H. K. Dyson. 7.30 p.m.